ProSoft TECHNOLOGY

Where Automation Connects.

inRAx®

MVI71-HART

PLC Platform

HART Multi-drop Master Communication Module

June 05, 2009

USER MANUAL

MVI (Multi Vendor Interface) Modules

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DÉCONNECTER L'EQUIPMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

CL I Div 2 GPs A, B, C, D
Temp Code T5
II 3 G
Ex nA IIC T5 X
0° C <= Ta <= 60° C
II - Equipment intended for above ground use (not for use in mines).
3 - Category 3 equipment, investigated for normal operation only.
G - Equipment protected against explosive gasses.

Important Installation Instructions

Power, Input and Output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

A WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIV. 2;
B WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES, and
C WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.
D "THIS DEVICE SHALL BE POWERED BY CLASS 2 OUTPUTS ONLY.

Warnings

North America Warnings

A Warning - Explosion Hazard - Substitution of components may impair suitability for Class I, Division 2.
B Warning - Explosion Hazard - When in Hazardous Locations, turn off power before replacing or rewiring modules.
Warning - Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be nonhazardous.
C Suitable for use in Class I, division 2 Groups A, B, C and D Hazardous Locations or Non-Hazardous Locations.

ATEX Warnings and Conditions of Safe Usage:

Power, Input, and Output (I/O) wiring must be in accordance with the authority having jurisdiction

A Warning - Explosion Hazard - When in hazardous locations, turn off power before replacing or wiring modules.
B Warning - Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
C These products are intended to be mounted in an IP54 enclosure. The devices shall provide external means to prevent the rated voltage being exceeded by transient disturbances of more than 40%. This device must be used only with ATEX certified backplanes.
D DO NOT OPEN WHEN ENERGIZED.

Electrical Ratings

- Backplane Current Load: 800 mA @ 5 V DC; 3mA @ 24V DC
- Operating Temperature: 0 to 60°C (32 to 140°F)
- Storage Temperature: -40 to 85°C (-40 to 185°F)
- Shock: 30g Operational; 50g non-operational; Vibration: 5 g from 10 to 150 Hz
- Relative Humidity 5% to 95% (non-condensing)
- All phase conductor sizes must be at least 1.3 mm(squared) and all earth ground conductors must be at least 4mm(squared).

Markings

ANSI / ISA	ISA 12.12.01 Class I Division 2, GPs A, B, C, D
CSA/cUL	C22.2 No. 213-1987
CSA CB Certified	IEC61010
ATEX	EN60079-0 Category 3, Zone 2 EN60079-15

243333

Warning: This module is not hot-swappable! Always remove power from the rack before inserting or removing this module, or damage may result to the module, the processor, or other connected devices.

Battery Life Advisory

All modules in the MVI series use a rechargeable Lithium Vanadium Pentoxide battery to backup the 512K SRAM memory, real-time clock, and CMOS. The battery should last for the life of the module.
The module must be powered for approximately twenty hours before it becomes fully charged. After it is fully charged, the battery provides backup power for the CMOS setup and configuration data, the real-time clock, and the 512K SRAM memory for approximately 21 days.
Before you remove a module from its power source, ensure that the battery within the module is fully charged. A fully charged battery will hold the BIOS settings (after being removed from its power source) for a limited number of days. When the battery is fully discharged, the module will revert to the default BIOS settings.

Note: The battery is not user replaceable.

Your Feedback Please

We always want you to feel that you made the right decision to use our products. If you have suggestions, comments, compliments or complaints about the product, documentation or support, please write or call us.

ProSoft Technology
5201 Truxtun Ave., 3rd Floor
Bakersfield, CA 93309
+1 (661) 716-5100
+1 (661) 716-5101 (Fax)
www.prosoft-technology.com

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MVI71-HART User Manual
June 05, 2009

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In an effort to conserve paper, ProSoft Technology no longer includes printed manuals with our product shipments. User Manuals, Datasheets, Sample Ladder Files, and Configuration Files are provided on the enclosed CD, and are available at no charge from our web site: www.prosoft-technology.com

Printed documentation is available for purchase. Contact ProSoft Technology for pricing and availability.

Asia Pacific: +603.7724.2080
Europe, Middle East, Africa: +33 (0) 5.3436.87.20
Latin America: +1.281.298.9109
North America: +1.661.716.5100

Contents

MVI (Multi Vendor Interface) Modules 2
Important Installation Instructions 2
Warnings 2
Battery Life Advisory 3
Your Feedback Please 3
ProSoft Technology® Product Documentation 4

Guide to the MVI71-HART User Manual **7**

1 Start Here **9**

1.1 System Requirements 9
1.2 Package Contents 10
1.3 Setting Jumpers 11
1.4 Install the Module in the Rack 11
1.5 Connect your PC to the Processor 13
1.6 Download the Sample Program to the Processor 14
1.7 Connect your PC to the Module 16

2 Module Configuration **17**

2.1 Installing and Configuring the Module 17
2.2 Module Data 18
2.3 Configuration File 19

3 Ladder Logic **41**

4 Diagnostics and Troubleshooting **43**

4.1 Reading Status Data from the Module 43
4.2 LED Status Indicators 57

5 Reference **59**

5.1 Product Specifications 59
5.2 Functional Overview 61
5.3 RS-232 Configuration/Debug Port 81
5.4 DB9 to RJ45 Adaptor (Cable 14) 83
5.5 Application Port Connection 84
5.6 Example Field Terminations 84
5.7 MVI71-HART Status Data Area and Error Codes 92
5.8 HART Universal Commands 98
5.9 HART Common Practice Commands 111

6 Support, Service & Warranty 141

6.1 How to Contact Us: Technical Support 141
6.2 Return Material Authorization (RMA) Policies and Conditions 142
6.3 LIMITED WARRANTY 143

Index 149

Guide to the MVI71-HART User Manual

Function		Section to Read	Details
Introduction (Must Do)	→	Start Here (page 9)	This Section introduces the customer to the module. Included are: package contents, system requirements, hardware installation, and basic configuration.
Verify Communication, Diagnostic and Troubleshooting	→	Verifying Communication (page 57) Diagnostics and Troubleshooting (page 43)	This section describes how to verify communications with the network. Diagnostic and Troubleshooting procedures.
Reference Product Specifications Functional Overview	→	Reference (page 59) Functional Overview (page 61) Product Specifications (page 59)	These sections contain general references associated with this product, Specifications, and the Functional Overview.
Support, Service, and Warranty Index	→	Support, Service and Warranty (page 141)	This section contains Support, Service and Warranty information. Index of chapters.

1 Start Here

In This Chapter

- System Requirements 9
- Package Contents 10
- Setting Jumpers 11
- Install the Module in the Rack 11
- Connect your PC to the Processor 13
- Download the Sample Program to the Processor 14
- Connect your PC to the Module 16

To get the most benefit from this User Manual, you should have the following skills:

- **Rockwell Automation® RSLogix™ software**: launch the program, configure ladder logic, and transfer the ladder logic to the processor
- **Microsoft Windows:** install and launch programs, execute menu commands, navigate dialog boxes, and enter data.
- **Hardware installation and wiring**: install the module, and safely connect HART Multidrop and PLC devices to a power source and to the MVI71-HART module's application ports.

Caution: You must be able to complete the application without exposing personnel or equipment to unsafe or inappropriate working conditions.

1.1 System Requirements

The MVI71-HART module requires the following minimum hardware and software components:

- Rockwell Automation PLC processor, with compatible power supply and one free slot in the rack, for the MVI71-HART module. The module requires 800mA of available power.
- The PLC Processor must provide for at least 64 words of BTR/BTW area, otherwise the module may not function correctly.
- Rockwell Automation RSLogix 5 programming software.
- Rockwell Automation RSLinx communication software
- Pentium® 100 MHz minimum. Pentium III 700 MHz (or better) recommended

- Supported operating systems:
  - Microsoft Windows XP
  - Microsoft Windows 2000
  - Microsoft Windows NT v4.0 with Service Pack 3 or greater
  - Microsoft Windows ME
  - Microsoft Windows 98
- 64 Mbytes of RAM minimum, 256 Mbytes of RAM recommended
- 100 Mbytes of free hard disk space (or more based on application requirements)
- 256-color VGA graphics adapter, 800 x 600 minimum resolution (True Color 1024 × 768 recommended)
- CD-ROM drive
- 3.5 inch floppy disk drive
- HyperTerminal or other terminal emulator program capable of file transfers using Zmodem protocol.

1.2 Package Contents

The following components are included with your MVI71-HART module, and are all required for installation and configuration.

Important: Before beginning the installation, please verify that all of the following items are present.

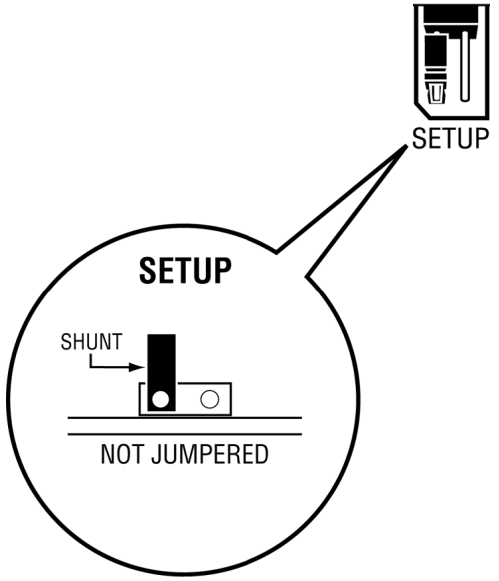
Qty.	Part Name	Part Number	Part Description
1	MVI71-HART Module	MVI71-HART	HART Multi-drop Master Communication Module
1	Cable	Cable #15, RS232 Null Modem	For RS232 Connection to the CFG Port
1	Cable	Cable #14, RJ45 to DB9 Male Adapter cable	For DB9 Connection to Module's Port

If any of these components are missing, please contact ProSoft Technology Support for replacement parts.

1.3 Setting Jumpers

The Setup Jumper acts as "write protection" for the module's flash memory. In "write protected" mode, the Setup pins are not connected, and the module's firmware cannot be overwritten. Do not jumper the Setup pins together unless you are directed to do so by ProSoft Technical Support.

The following illustration shows the MVI71-HART jumper configuration.



Note: If you are installing the module in a remote rack, you may prefer to leave the Setup pins jumpered. That way, you can update the module's firmware without requiring physical access to the module.

1.4 Install the Module in the Rack

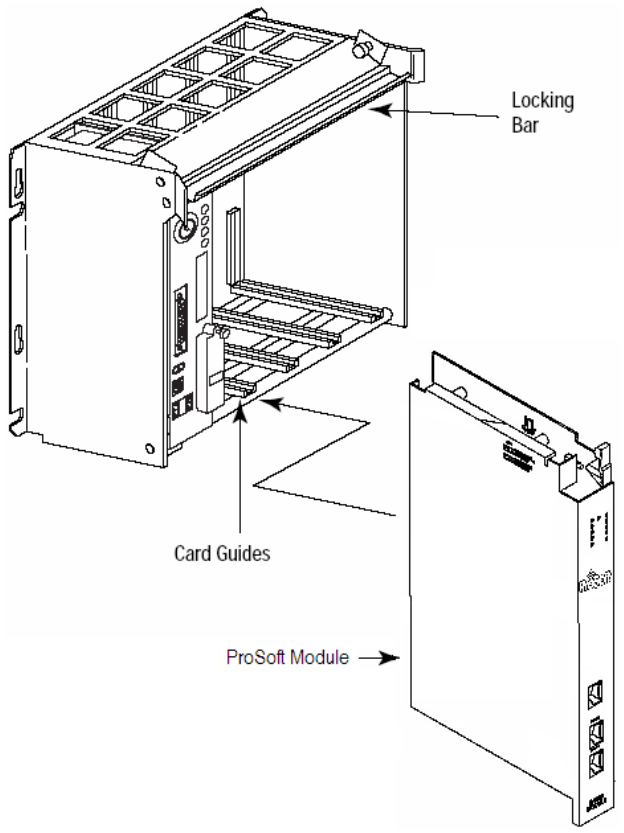
If you have not already installed and configured your PLC processor and power supply, please do so before installing the MVI71-HART module. Refer to your Rockwell Automation product documentation for installation instructions.

Warning: You must follow all safety instructions when installing this or any other electronic devices. Failure to follow safety procedures could result in damage to hardware or data, or even serious injury or death to personnel. Refer to the documentation for each device you plan to connect to verify that suitable safety procedures are in place before installing or servicing the device.

After you have checked the placement of the jumpers, insert MVI71-HART into the PLC™ chassis. Use the same technique recommended by Rockwell Automation to remove and install PLC modules.

Warning: This module is not hot-swappable! Always remove power from the rack before inserting or removing this module, or damage may result to the module, the processor, or other connected devices.

1. Turn power OFF.
2. Align the module with the top and bottom guides, and slide it into the rack until the module is firmly against the backplane connector.

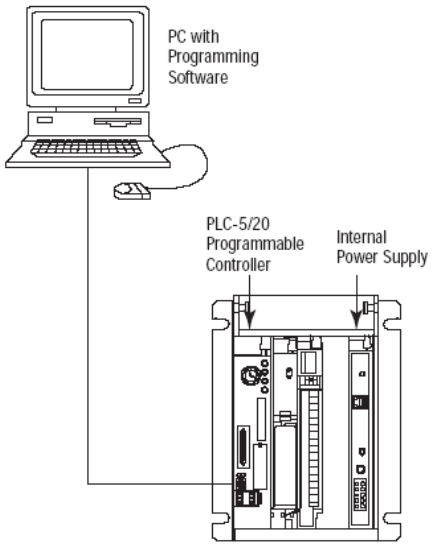


3. With a firm but steady push, snap the module into place.
4. Check that the holding clips on the top and bottom of the module are securely in the locking holes of the rack.
5. Make a note of the slot location. You will need to identify the slot in which the module is installed in order for the sample program to work correctly. Slot numbers are identified on the green circuit board (backplane) of the PLC rack.
6. Turn power ON.

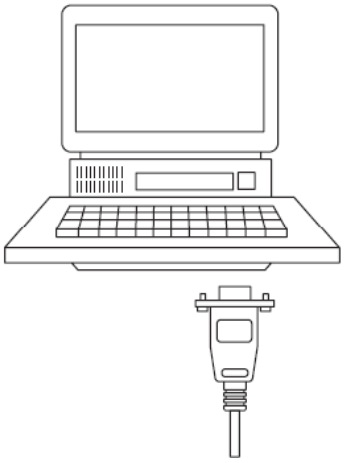
Note: If you insert the module improperly, the system may stop working, or may behave unpredictably.

1.5 Connect your PC to the Processor

1 Connect the right-angle connector end of the cable to your controller at the communications port.



2 Connect the straight connector end of the cable to the serial port on your computer.

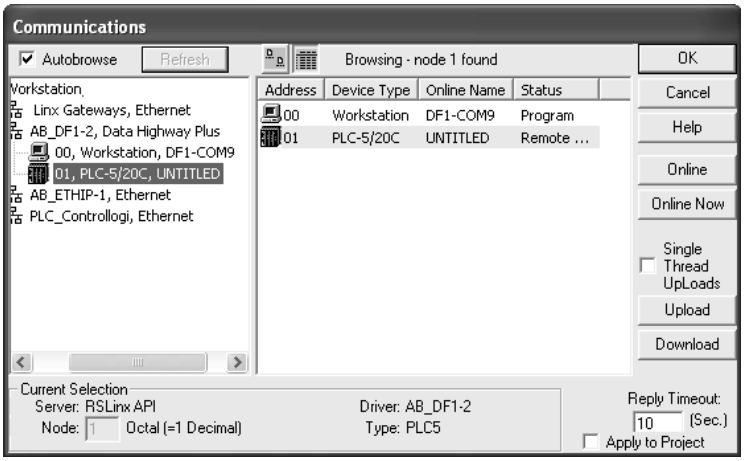


1.6 Download the Sample Program to the Processor

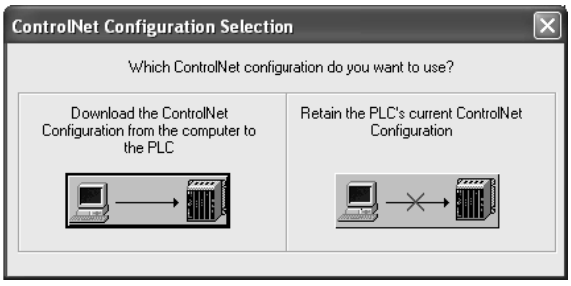
To download the sample program from RSLogix 5 to the PLC processor:

Note: The key switch on the front of the PLC processor must be in the REM position.

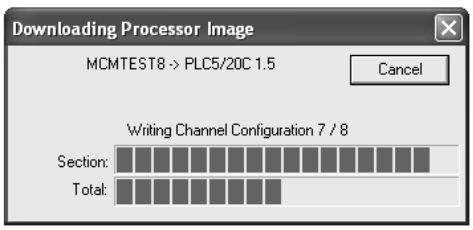
1 If you are not already online to the processor, open the Communications menu, and then choose Download. RSLogix will establish communication with the processor.



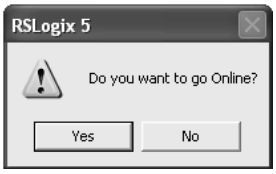
2 Click the Download button to transfer the sample program to the processor.
3 When prompted, choose Computer to PLC


ControlNet Configuration Selection
Which ControlNet configuration do you want to use?
Download the ControlNet Configuration from the computer to the PLC
Retain the PLC's current ControlNet Configuration

4 RSLogix will compile the program and transfer it to the processor. This process may take a few minutes.



5 When the download is complete, RSLogix will open another confirmation dialog box. Click OK to switch the processor from Program mode to Run mode.

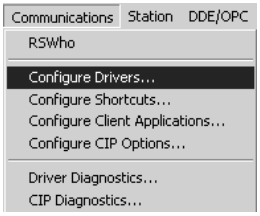


Note: If you receive an error message during these steps, refer to your RSLogix documentation to interpret and correct the error.

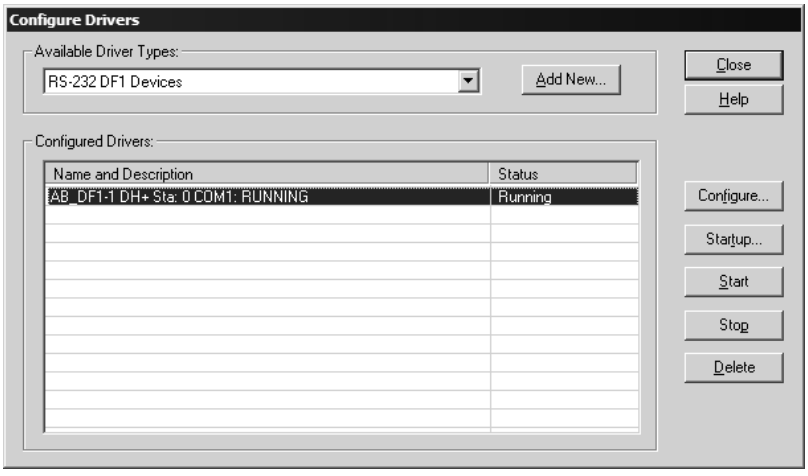
1.6.1 Configuring RSLinx

If RSLogix is unable to establish communication with the processor, follow these steps

1 Open **RSLINX.**
2 Open the **COMMUNICATIONS** menu, and choose **CONFIGURE DRIVERS**.



This action opens the **CONFIGURE DRIVERS** dialog box.



Note: If the list of configured drivers is blank, you must first choose and configure a driver from the Available Driver Types list. The recommended driver type to choose for serial communication with the processor is RS-232 DF1 DEVICES.

3 Click to select the driver, and then click **CONFIGURE.** This action opens the **CONFIGURE ALLEN-BRADLEY DF1 COMMUNICATIONS DEVICE** dialog box.

4 Click the **AUTO-CONFIGURE** button. RSLinx will attempt to configure your serial port to work with the selected driver.
5 When you see the message **AUTO CONFIGURATION SUCCESSFUL**, click the **OK** button to dismiss the dialog box.

Note: If the auto-configuration procedure fails, verify that the cables are connected correctly between the processor and the serial port on your computer, and then try again. If you are still unable to auto-configure the port, refer to your RSLinx documentation for further troubleshooting steps.

1.7 Connect your PC to the Module

With the module securely mounted, connect your PC to the Configuration/Debug port using the RJ45-DB-9 Serial Adapter Cable and the Null Modem Cable included in the package with the MVI71-HART module.

1 Connect the RJ45-DB-9 Serial Adapter Cable to the Null Modem Cable.
2 Insert the RJ45 cable connector from the RJ45-DB-9 cable into the Configuration/Debug port of the module.
3 Attach the other end to the serial port on your PC.

2 Module Configuration

In This Chapter

- Installing and Configuring the Module 17
- Module Data 18
- Configuration File 19

This section contains the setup procedure, data, and ladder logic for successful application of the MVI71-HART module. Each step in the setup procedure is defined in order to simplify the use of the module.

2.1 Installing and Configuring the Module

This chapter describes how to install and configure the module to work with your application. The configuration process consists of the following steps.

1. Modify the module's configuration files to meet the needs of your application, and copy the updated configuration to the module. Example configuration files are provided on the CD-ROM. Refer to the Modifying the Example Configuration File section, later in this chapter, for more information on the configuration files.
2. Modify the example ladder logic to meet the needs of your application, and copy the ladder logic to the processor. Example ladder logic files are provided on the CD-ROM.

Note: If you are installing this module in an existing application, you can copy the necessary elements from the example ladder logic into your application.

The rest of this chapter describes these steps in more detail.

The next step in installing and configuring the module is to define whether the block transfer or side-connect interface will be utilized. If the block transfer interface is to be used you should be ready to connect the module to the HART network if the ladder logic is defined correctly.

Next, define the data files to be used with the application. Define the data files to hold the user data (read and write data). Enter the ladder logic to handle the blocks transferred between the module and the PLC. Download the program to the PLC and test the program with the module.

The module is now set up and ready to be used with your application. Insert the module in the rack (with the power turned off) and attach the serial communication cables. Download the new application to the controller and place the processor in run mode. Download the new HART.CFG file to the module using a terminal emulation program. If all the configuration parameters are set

correctly and the module is attached to a network, the module's Application LED (APP LED) should remain off and the backplane activity LED (BP ACT) should blink very rapidly. Refer to the **Troubleshooting** section if you encounter errors. Attach a computer or terminal to Port 0 on the module and look at the status of the module using the Configuration/Debug Menu in the module.

2.2 Module Data

All data related to the MVI71-HART module is stored in a user defined data files. It is the responsibility of the ladder logic programmer to construct all the data files required by the program and to write the ladder logic required to interface to these files. The ladder logic is also responsible for transferring floating-point data between the files used for data transfer (integer files) and floating-point files.

2.2.1 Status Data

When the side-connect interface is employed in the application, the status data is automatically transferred from the module to the first file used by the interface. The data is placed at an offset of 0 in the file and has the format shown in MVI71-HART Status Data Area and Error Codes (page 92).

When the block transfer interface is used, the status data is transferred to the module in blocks with identification codes of 0 and -1. Data in these blocks should be moved to a user data file. The format of the data passed to the PLC is shown in MVI71-HART Status Data Area and Error Codes (page 92) with the data starting at word 2 in the BTR block.

2.2.2 User Data

When the side-connect interface is utilized, the read and write data is moved between the module and the processor without any ladder logic. The size of the data area and position of the data areas in the module's database is determined by the parameters set in the configuration file. You must transfer floating-point values to float files.

When the block transfer interface is used, ladder logic is required to page the data between the module and the processor. The size of the data area and position of the data areas in the module's database is determined by the parameters set in the configuration file.

The read data area should be set to match the value entered in the **Read Register Count** parameter of the HART.CFG file. For ease of use, this array should be dimensioned as an even increment of 60 words. This data is paged up to 60 words at a time from the module to the processor. The Read Data task is responsible for placing the data received into the proper position in the read data array. Use this data for status and control in the ladder logic of the processor.

The write data area should be set to match the value entered in the **Write Register Count** parameter of the HART.CFG file. For ease of use, this array should be dimensioned as even increments of 60 words. This data is paged up to 60 words at a time from the processor to the module. The Write Data task is responsible for placing the write data into the output image for transfer to the module. This data is passed from the processor to the module for status and control information for use in other nodes on the network.

2.2.3 Command Control Data

This data area passes control information from the processor to the module. Refer to the command control section in this document for a complete description of the format used for these data blocks.

2.3 Configuration File

In order for the module to operate, a configuration file (HART.CFG) is required. This configuration file contains all the information required to configure the module's master drivers and establish a command list for each port. Each parameter in the file must be set carefully in order for the application to be implemented successfully. The ProSoft Solutions CD contains an example listing of a HART.CFG file.

The configuration file is separated into sections, with topic header names enclosed in the **[ ]** characters. The configuration file consists of the following sections:

Section	Description
[MODULE]	General module level parameters
[HART PORT 0]	HART port configuration parameters
[HART PORT 1]	HART port configuration parameters
[HART PORT 2]	HART port configuration parameters
[HART PORT 3]	HART port configuration parameters
[HART PORT 0 COMMANDS]	HART command list for port
[HART PORT 1 COMMANDS]	HART command list for port
[HART PORT 2 COMMANDS]	HART command list for port
[HART PORT 3 COMMANDS]	HART command list for port

After each section header, the file contains a set of parameters. Unique labels are used under each section to specify a parameter. Each label in the file must be entered exactly as shown in the file for the parameter to be identified by the program. If the module is not considering a parameter, look at the label for the data item. Each parameter's value is separated from the label with the "**:**" character. This character is used by the program to delimit the position in the data record where to start reading data. All data for a parameter must be placed after the "**:**" character. For numeric parameter values, any text located after the value will not be used. There must be at least one space character between the end of the parameter value and the following text. An example of a parameter entry is given below:

```
Preambles: 5 #Set preamble character count for each frame
```

The parameter label is "Preambles" and the parameter value is 5. The characters after the parameter value are ignored and are used for internal documentation of the configuration file.

Any record that begins with the "**#**" character is considered to be a comment record. These records can be placed anywhere in the file as long as the "**#" character** is found in the first column of the line. These lines are ignored in the file and can be used to provide documentation within the configuration file. Liberal use of comments within the file can ease the use and interpretation of the data in the file.

Use any text editor to alter the supplied HART.CFG file for the specific application. You must enter each parameter correctly for successful application of the module. The following topics contain a complete listing of all parameters utilized by the module with a definition of each parameter.

2.3.1 [MODULE]

The module section contains the data that applies to the whole module and includes the backplane data transfer parameters.

```
[Module]
Module Name: Test Example of MVI71-HART Communication Module
Read Register Start :    0 #Starting DB address where read by processor
Read Register Count :  300 #Number of regs for processor to read
Write Register Start:  300 #Starting DB address where write data placed
Write Register Count:  300 #Number of regs to write to module from processor
Error/Status Offset : 2500 #Location of port error/status offset data
Failure Flag Count  :    0 #Determines if BP failure will cause protocol to be
                           #disabled (0=Ignore, >0 = failure count to disable)
Initialize Output Data:  No#Initialize the database file on startup
```

The following table describes the content of this section:

[SECTION]/Item	Range	Description
[MODULE]		Header for module section.
Module Name:	Up to 80 characters	This field contains a user assigned name for the module.
Read Register Start:	0 to 3999	This parameter sets the starting register in the modules database where data will be transferred from the module to the processor.
Read Register Count:	0 to 4000	This parameter sets the number of registers to transfer from the module to the processor.
Write Register Start:	0 to 3999	This parameter specifies the starting register in the module where to place data received from the processor.
Write Register Count:	0 to 4000	This parameter specifies the number of registers to accept from the processor.
Error/Status Offset:	-1 or 0 to 3935	This parameter defines the database location where the module status data will be stored. If set to -1, data not placed in database.

[SECTION]/Item	Range	Description
Failure Flag Count:	0 to 65535	This parameter specifies the number of successive transfer errors that must occur before the communication ports are shut down. If the parameter is set to 0, the communication ports will continue to operate under all conditions. If the value is set larger than 0 (1 to 65535), communications will cease if the specified number of failures occur.
Initialize Output Data	Yes or No	If this parameter is set to "Yes", it prevents the database in the module from resetting all registers to zero after a boot-up. Instead, during power up, the module will generate Read Blocks containing special Write Block IDs (1000 to 1067). The ladder logic is required to update the last data in the PLC memory to the MVI71-HART module. The number of blocks transferred is based on how the ReadData register count is setup in the module definition parameters of the loaded configuration file. If this parameter is set to "No", it clears the registers after boot up.

2.3.2 [HART PORT x]

The [HART PORT *x*] sections of the configuration file set the HART channel communication parameters, define the protocol specifics and set the command list parameters. The parameters are the same for all ports. The command list for each HART channel is entered in a different section of the file.

Enabled

Y or N

This parameter enables or disables the specific HART channel. If the parameter is set to "Y", the channel will be utilized. If set to "N", the channel will not be used.

Preambles

5 to 20

This parameter sets the number of preambles to be transmitted before each message is sent from the channel. The value of 5 is normally utilized for the parameter. It can be set to a value from 5 to 20.

Primary Master

Y or N

This parameter determines if the specific HART channel will emulate a primary or secondary master. You can have only one of each type on a HART network. If you plan on using a handheld device (secondary master), you must set the parameter to 'Y'. If the parameter is set to 'Y', the channel will act as the primary master. A value of 'N' will set the channel to act as a secondary master.

Retry Count

0 to 10

This parameter sets the number of retries for a command if the command response is not received from the slave device. This parameter is normally set to a value of 3. The module will accept values of 0 to 10.

DB Address Status

-1, 0 to 3999

This parameter is utilized to set the database address in the module where the status word for the channel will be placed. If the parameter is set to -1, the word value will not be placed in the database. If a value from 0 to 3999 is set for the parameter, the status word for the channel will be placed at the specified database offset. This word is bit mapped with each bit representing a slave device. The bit will be set if slave device has a communication error.

Slave List Status

The configuration parameter "DB Address Status" defines the register address in the virtual database where the status data for each HART channel will be placed. This word has one bit for each HART device and if this bit is in "1" it means that the corresponding HART device is not answering to the poll.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
HART Device	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

The bit 0 of the "Slave List Status" is used for a slave connected in a point-to-point configuration. In this mode, the slave's 4 to 20 milliamp signal will also be active and can be utilized by an analog input or out module depending on the signal type.

Command Count

0 to 99

This parameter sets the number of user commands to be utilized. The first command in the list is always reserved for the auto-poll command so the user should configure this value considering one command for the auto-poll. For example, if the user configures two commands, the command count parameter should be set as 3. This parameter can be set from 0 to 99. If the parameter is set to a value other than 0, commands should be present in the [HART PORT x COMMANDS] section.

Auto-Poll Code

P, M or N

This parameter sets the auto-poll mode of the channel. If the parameter is set to P, the module will automatically poll device 0 in point-to-point mode. If the parameter is set to M, the module will automatically poll devices 1 to n (n=value of parameter Max Device Count). If the parameter is set to N, the auto-polling option will be disabled and only commands in the command list will be utilized for the channel. In the auto-poll mode, the module will automatically execute HART commands 0, 3, 13, 14 and 15.

Auto-Poll DB Address

0 to 3700

This parameter sets the starting address for the data obtained by the auto-poll feature. Each device on a channel requires 50 words in the database. The data area selected must not overlap any portion of the database used by other channels or the module.

Auto-Poll Swap Float

0 to 3

This parameter swaps the floating-point data values received by the auto-poll feature.

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

Depending on the host processor using the data, the proper swap code must be utilized to present the data in the correct format.

Max Device Count

1 to 15

This parameter sets the maximum number of slave devices to be utilized for the auto-poll feature. In point-to-point mode, the parameter should be set to a value of 1. In multi-drop mode, the parameter should be set from 1 to 15 to represent the number of slave devices attached to the channel.

Error/Status Offset

-1 or 0 to 3935

This parameter defines the database location where the module status data will be stored. If set to -1, data not placed in database.

2.3.3 [HART PORT x COMMANDS]

The [HART PORT *x* COMMANDS] sections of the CFG file set the user defined HART channel command lists. These lists poll slave devices attached to the HART channels. The module supports numerous commands.

The command list is formatted differently than the other sections of the configuration file. Commands are present in a block between the labels **START** and **END**. These labels inform the program where the list resides. The module's program will parse all commands after the **START** label until it reaches the **END** label or until the command count entered for the port is reached.

Command List Overview

The MVI71-HART module uses a command list to interface with HART slave devices. The commands in the list specify

- the slave device to be addressed
- the function to be performed (read or write)
- the registers in the internal database to be associated with the device data.

There is a separate command list for each HART channel, with up to 99 commands allowed per channel. The command list is processed from top (command #0) to bottom.

A poll interval parameter is associated with each command to specify a minimum delay time in seconds between the issuance of a command. For example, a poll interval of 10 executes the command no more frequently than every 10 seconds.

Write commands have a special feature, as they can be set to execute only if the data in the write command changes. If the register data values in the command have not changed since the command was last issued, the command will not be executed. If the data in the command has changed since the command was last issued, the command will be executed. Use of this feature can lighten the load on the HART network. In order to implement this feature, set the enable code for the command to a value of 2.

The module supports all the Universal (page 98) and Common Practice (page 111) commands, as well as device specific commands. A Device Specific command is supported without any translation of the data.

Commands Supported by the Module

The format of each command in the list is independent on the function being executed. All parameters in the command table must be entered. Only one parameter is optional, the Fixed Data field, which contains data to be sent to a HART device. The tables below list the functions supported by the module:

HART Universal Commands Set

Command	Definition
00	Read Unique Identifier
01	Read Primary Variable
02	Read Current And Percent Of Range
03	Read Dynamic Variables
06	Write Polling Address
07	Read Loop Configuration
08	Read Dynamic Variable Classifications
09	Read Device Variables with Status
11	Read Unique Identifier Associated With Tag
12	Read Message
13	Read Tag Descriptor Date
14	Read PV Sensor Info
15	Read Output Information
16	Read Final Assembly Number

Command	Definition
17	Write Message
18	Write Tag Descriptor Date
19	Write Final Assembly Number
20	Read Long Tag
21	Read Unique Identifier Associated With Long Tag
22	Write Long Tag

HART Common Practice Commands Set

Command	Definition
33	Read Transmitter Variables
34	Write Damping Value
35	Write Range Values
36	Set Upper Range Value
37	Set Lower Range Value
38	Reset Configuration Changed Flag
39	EEPROM Control
40	Enter Exit Fixed Current Mode
41	Perform Transmitter Self Test
42	Perform Master Reset
43	Set PV Zero
44	Write PV Units
45	Trim DAC Zero
46	Trim DAC Gain
47	Write Transfer Function
48	Read Additional Transmitter Status
49	Write PV Sensor Serial Number
50	Read Dynamic Variable Assignments
51	Write Dynamic Variable Assignments
52	Set Transmitter Variable Zero
53	Write Transmitter Variable Units
54	Read Transmitter Variable Information
55	Write Transmitter Variable Damping Value
56	Write Transmitter Variable Sensor Serial Number
57	Read Unit Tag Descriptor Date
58	Write Unit Tag Descriptor Date
59	Write Number Of Response Preambles
60	Read Analog Channel and Percent of Range
61	Read Dynamic Variables and PV Analog Ch
62	Read Analog Channels
63	Read Analog Channel Information
64	Write Analog Channel Additional Damping Value
65	Write Analog Channel Range Values
66	Enter/Exit Fixed Analog Channel Mode
67	Trim Analog Channel Zero
68	Trim Analog Channel Gain
69	Write Analog Channel Transfer Function
70	Read Analog Channel Endpoint Values

Command	Definition
71	Lock Device
72	Squawk
73	Find Device
74	Read I/O System Capabilities
75	Poll Sub-Device
76	Read Lock Device State
79	Write Device Variable
80	Read Device Variable Trim Points
81	Read Device Variable Trim Guidelines
82	Write Device Variable Trim Point
83	Reset Device Variable Trim
105	Read Burst Mode Configuration
106	Flush Delayed Responses
107	Write Burst Device Variables
108	Write Burst Mode Command Number
109	Burst Mode Control
110	Read All Dynamic Variables

Enable

0, 1, 2, 3, 4, 5

This field defines whether or not the command is to be executed and under what conditions.

Code	Description
0	The command is disabled and will not be executed in the normal polling sequence. This can be used to process a command from a bursting slave device.
1	Causes the command to be executed each scan of the command list if the Poll Interval Time is set to zero. If the Poll Interval time is set, the command will be executed, when the interval timer expires.
2	The command will execute only if the internal data associated with the command changes. This value is valid only when there is a specified "Write DB Address" (see below) with a non zero byte count for write commands.
3	The HART module will send the command if either the MVI71-HART module OR the HART device is powered up. This is mainly used for configuration of HART devices on startup.
4	Places the command in enabled mode. This option is valid only if there is a specified "Enabled DB Address" (see below). If the Virtual Database word specified in "Enabled DB Address" has "-1" the command will be executed otherwise it will not.
5	Places the command in one shot enabled mode. This option is valid only if there is a specified "Enabled DB Address" (see below). If the Virtual Database word specified in "Enabled DB Address" has a value of "-1" the command will be executed otherwise it will not. When the command has been successful the Virtual Database word specified in "Enabled DB Address" will be written with "0", so the command will be executed only once.

Refer to Command Enable Control Block (9902) (page 67) and Command Disable Control Block (9903) (page 67) for more information on how to use the enable code.

Float DB Address

0 to 3998

This field specifies the internal database register where the floating point values returned by the command will be placed.

Poll Interval

0 to 65535

This parameter specifies the minimum interval to execute continuous commands (Enable code of 1). The parameter is entered in units of seconds. Therefore, if a value of 10 is entered for a command, the command will execute no more frequently than every 10 seconds.

Word Count

-1 to 125

This parameter specifies the number of words from the floating point data returned by a HART command that will be placed on the Virtual Database. If this parameter is 0 no data will be written to the Database. If this parameter is -1 then all the floating point data will be written in the integer block of data.

Special care should be taken with this number, because is a word count and a floating point value is 2 words long. For example if you execute a HART command 3 which takes 5 floating point values from the device, you should place a word count of 10 words.

Swap Code

0,1,2,3

This parameter defines the byte order of each four-byte group of data received. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard byte order for storing these data types. The following table describes the values and their associated operations:

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

Short Address

1 to 15

This parameter specifies the HART slave node address on the network to be considered. Values of 1 to 15 are permitted. If the device to be addressed only accepts long address, then the parameter "Use Long" should be selected so the module can ask for the long address with the short one and then execute the command.

Function Code

0 to 255

This parameter specifies the HART function to be executed. Any HART function can be executed, even device specific ones, but only supported commands will return formatted data and classified in floating point data and integer data.

Int. DB Address

0 to 3999

This field specifies the internal database register where the integer or packed ASCII string values returned by the command will be placed.

If the Floating Point Word Count parameter is "-1", then all the data returned by the HART command will be placed in this address without any formatting.

Word Count

0 to 125

This parameter specifies the number of words from the integer or packed ASCII string data returned by a HART command that will be placed on the Virtual Database. If this parameter is "0", no data will be written to the Database.

Swap Code

0,1,2,3

This parameter defines the byte order of each four-byte group of data received. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard byte order for storing these data types. The following table describes the values and their associated operations:

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

Use Long

0 or 1

This parameter defines if the command will be executed with short or long address. If the value is "0", then the configured command will be executed using the Short Address specified. If the value is "1" then the specified Short Address will be used only to ask for the long address and that will be used to execute the configured command.

Enable DB Address

0 to 3999

This field specifies the internal database register to be used to enable the execution of a command. This parameter is only used if "Enable" is "4" or "5". If the value of this database register is "-1", then the command will be executed, otherwise it will not. If the "Enable" value is "5", then after the successful execution of the command this value will become "0"

Done DB Address

-1 to 3999

This field specifies the internal database register to be used to signal the successful execution of a command. When a command is successfully executed a "-1" is written to this register. This "Done DB Address" can be shared with the "Enable DB Address" of another command to do a chained command execution.

Write DB Address

-1 to 3999

This field specifies the internal database register to be as a source of data for HART command which includes data. It is possible to include data with every HART command, but it depends of the command and of the device if it will accept this data.

If this value is "-1", it indicates that there will not be data with the command or that it will not come from database.

Swap Code

0,1,2,3

This parameter defines the byte order of each four-byte group of data received. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard byte order for storing these data types. The following table describes the values and their associated operations:

Swap Code	Description
0	None - No Change is made in the byte ordering (1234 = 1234)
1	Words - The words are swapped (1234=3412)
2	Words & Bytes - The words are swapped then the bytes in each word are swapped (1234=4321)
3	Bytes - The bytes in each word are swapped (1234=2143)

Byte Count

0 to 250

This parameter specifies the number of bytes to be sent to a HART device in the command. If the command has no data then this value should be "0".

If the value of this field is different of "0" and "Write DB Address" is different of "-1" then the data for the command will be taken from the Virtual Database. If the value of this field is different of "0" and "Write DB Address" is "-1" then the data for the command will be from the "Fixed Data" field for the command.

Fixed Data

Up to 250 HEX values separated by space

This parameter is a string of HEX values to be sent with the HART command. There should be at least the number of bytes specified in the "Byte Count" parameter. The bytes should be written in hexadecimal format and separated by a space. This data will be sent if the Parameter "Write DB Address" is "-1" and "Byte Count" is greater than "0", and it will be sent in the same order that they are written.

2.3.4 Hart Command Examples

This section describes two examples that shows how to configure HART commands. The first example shows a read command (function code 3 - READ DYNAMIC VARIABLES) and the second example shows a write command (function 34 - WRITE DAMPING VALUE).

Example of HART Command Function 3

The following example shows how to configure a command function 3 (READ DYNAMIC VARIABLES) to read the process variables from the HART slave device. According to the HART specification, this command will return four floating-point variables:

Word	High Byte	Low Byte
0	Current (mA)	
1		
2	Primary Variable	
3		
4	Second Variable	
5		
6	Third Variable	
7		
8	Fourth Variable	
9		

The command also returns the following integer data:

Word	High Byte	Low Byte
0	Status Word	
1	Primary Variable Units Code	Second Variable Units Code
2	Third Variable Units Code	Fourth Variable Units Code

So, this command will return the following number of words:

Parameter	Data Type	Direction	Number of Words	Database Address (this example)
Variable Results	Floating Point	Read from slave to MVI	10	240 (word address)
Status/Unit Codes	Integer	Read from slave to MVI	3	290 (word address)

The user can configure the command parameters as described in the following table in order to correctly read the command 3 results to the module database:

Index	Parameter	Value	Observation
1	Enable	1	The command is sent continuously
2	Float DB Address	240	The floating point results will be copied to the internal database starting at word-address 240 (from 240 to 249)
3	Poll Interval	0	The command is sent without any delay
4	Word Count	10	The command returns 10 words of floating point data
5	Swap Code	3	The bytes in each returned floating point word are swapped
6	Short Address	0	This command is sent to the Hart slave device using short address 0
7	Function Code	3	The command function 3 (READ DYNAMIC VARIABLES) is used in this example
8	Int. DB Address	290	The integer data will copied to the database starting at word-address 290 (from 290 to 292)
9	Word Count	3	The command returns 3 words of integer data
10	Swap Code	3	The bytes in each returned integer data will be swapped
11	Use Long	1	This command executes using Long Address
12	Enable Address	-1	This command does not use this feature
13	DB Done Address	-1	This command does not use this feature
14	DB Write Address	-1	This parameter is ignored since no data is sent to the HART device (this is a read command)
15	DB Swap Code	3	This parameter is ignored since no data is sent to the HART device (this is a read command)
16	Byte Count	0	This parameter is ignored since no data is sent to the HART device (this is a read command)
17	Fixed Data		This command does not use this feature

So these values could be entered in the configuration file as described below:

```
START
#     1        2        3     4    5       6    7       8     9   10   11      12      13       14      15    16    17
#       Float DB     Poll  Word Swap   Short Func Int. DB  Word Swap  Use  Enable DB Done DB Write DB Swap  Byte Fixed
#Enable  Address Interval Count Code Address Code Address Count Code Long Address Address  Address    Code  Count Data
      1      240        0    10    3       0    3     290     3    3    1      -1      -1       -1       3      0
END
```

In this example, the user should verify that the command result is located inside the Read Data area, in order to have the data copied to the PLC processor (through the backplane). The following backplane configuration could be used for this example:

```
Read Register Start :    0 #Starting DB address where read by processor
Read Register Count :  300 #Number of regs for processor to read
Write Register Start:  300 #Starting DB address where write data placed
Write Register Count:  300 #Number of regs to write to module from processor
```

Example of HART Command Function 34

The following example shows how to configure a command function 34 (WRITE DAMPING VALUE) to write a damping values (seconds) to the HART slave device.

According to the HART specification, this command will write one floating point variables:

Word	High Byte	Low Byte
0	Floating Point Damping Value (Sec)	
1		

The HART device should also return the floating point value after it processes the request:

Word	High Byte	Low Byte
0	Floating Point Damping Value (Sec)	
1		

The HART device also returns an integer status data:

Word	High Byte	Low Byte
1	STATUS WORD	

This command will return the following number of words:

Parameter	Data Type	Direction	Number of Words	Database Address (this example)
Damping Value	Floating Point	Written from MVI to slave	2 (4 bytes)	400 (word address) or 800 (byte address)
Damping Value	Floating Point	Read from slave to MVI	2	240 (word address)
Status Word	Integer	Read from slave to MVI	1	290 (word address)

The user can configure the command parameters as described in the following table.

Index	Parameter	Value	Observation
1	Enable	1	The command is sent continuously
2	Float DB Address	300	The damping value response will be copied to the internal database starting at word-address 300 (occupies addresses 300 to 301)
3	Poll Interval	0	The command is sent without any delay

Index	Parameter	Value	Observation
4	Word Count	2	The command returns 10 words of floating point data
5	Swap Code	3	The bytes in each returned floating point word are swapped
6	Short Address	0	This command is sent to the Hart slave device using short address 0
7	Function Code	34	The command function 4 (WRITE DAMPING VALUE) is used in this example
8	Int. DB Address	320	The integer data will copied to the database word-address 320
9	Word Count	1	The command returns 1 word of integer data
10	Swap Code	3	The bytes in each returned integer data will be swapped
11	Use Long	1	This command executes using Long Address
12	Enable Address	-1	This command does not use this feature
13	DB Done Address	-1	This command does not use this feature
14	DB Write Address	800	The floating point value located at byte-address 800 (word-address 400) will be used as the damping value to be written to the HART device
15	DB Swap Code	3	The bytes in each returned integer data will be swapped
16	Byte Count	4	The command will write 4 bytes (2 words) to the HART device, since the damping value uses floating point format (2 words)
17	Fixed Data		This command does not use this feature

```
START
#      1        2        3     4    5       6    7       8     9   10   11      12      13       14      15    16    17
#        Float DB     Poll  Word Swap   Short Func Int. DB  Word Swap  Use  Enable DB Done DB Write DB Swap  Byte Fixed
# Enable  Address Interval Count Code Address Code Address Count Code Long Address Address  Address    Code Count  Data
       1      300        0     2    3       0   34     320     1    3    1      -1      -1       800       3     4
END
```

The user would have to verify that addresses 300 and 320 are located inside the Read Data area (read from the MVI database to the PLC processor). Address 400 would have to be located inside the Write Data area (written from the PLC processor to the MVI database).

2.3.5 Uploading and Downloading the Configuration File

ProSoft modules are shipped with a pre-loaded configuration file. In order to edit this file, you must transfer the file from the module to your PC. After editing, you must transfer the file back to the module.

This section describes these procedures.

Important: The illustrations of configuration/debug menus in this section are intended as a general guide, and may not exactly match the configuration/debug menus in your own module. For specific information about the configuration/debug menus in your module, refer to The Configuration/Debug Menu (page 43).

Required Hardware

You can connect directly from your computer's serial port to the serial port on the module to view configuration information, perform maintenance, and send (upload) or receive (download) configuration files.

ProSoft Technology recommends the following minimum hardware to connect your computer to the module:

- 80486 based processor (Pentium preferred)
- 1 megabyte of memory
- At least one UART hardware-based serial communications port available. USB-based virtual UART systems (USB to serial port adapters) often do not function reliably, especially during binary file transfers, such as when uploading/downloading configuration files or module firmware upgrades.
- A null modem serial cable.

Required Software

In order to send and receive data over the serial port (COM port) on your computer to the module, you must use a communication program (terminal emulator).

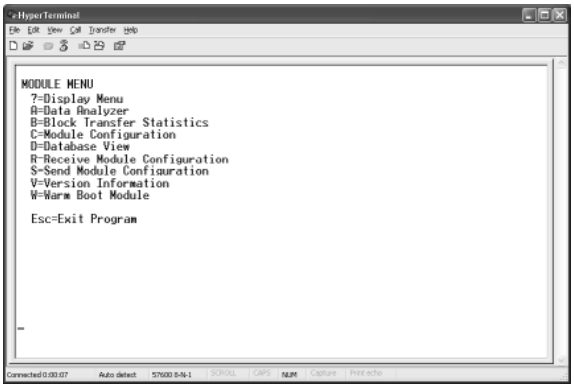
A simple communication program called HyperTerminal is pre-installed with recent versions of Microsoft Windows operating systems. If you are connecting from a machine running DOS, you must obtain and install a compatible communication program. The following table lists communication programs that have been tested by ProSoft Technology.

DOS	ProComm, as well as several other terminal emulation programs
Windows 3.1	Terminal
Windows 95/98	HyperTerminal
Windows NT/2000/XP	HyperTerminal

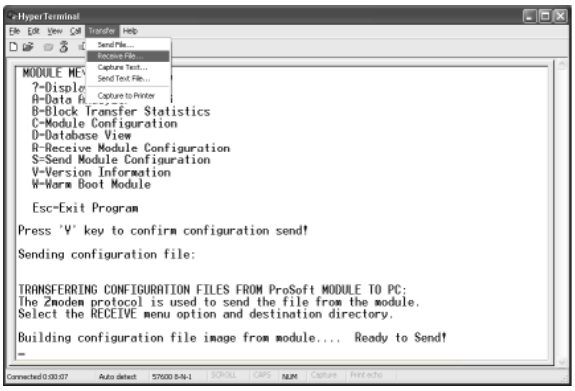
The module uses the Zmodem file transfer protocol to send (upload) and receive (download) configuration files from your module. If you use a communication program that is not on the list above, please be sure that it supports Zmodem file transfers.

Transferring the Configuration File to Your PC

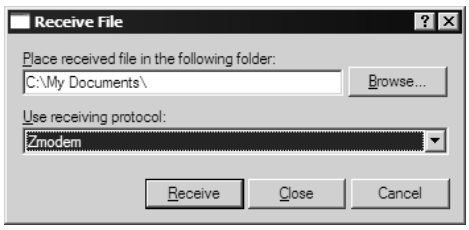
1 Connect your PC to the Configuration/Debug port of the module using a terminal program such as HyperTerminal. Press **[?]** to display the main menu.



2 From the **Transfer** menu in HyperTerminal, select **Receive File**.

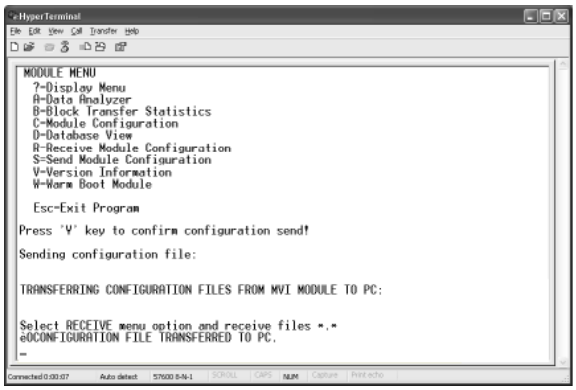

HyperTerminal
File Edit View Call Transfer Help
Send File...
Receive File...
Capture Text...
Send Text File...
Capture to Printer
B=Block Transfer Statistics
C=Module Configuration
D=Database View
R=Receive Module Configuration
S=Send Module Configuration
V=Version Information
W=Warm Boot Module
Esc=Exit Program
Press 'Y' key to confirm configuration send!
Sending configuration file:
TRANSFERRING CONFIGURATION FILES FROM ProSoft MODULE TO PC:
The Zmodem protocol is used to send the file from the module.
Select the RECEIVE menu option and destination directory.
Building configuration file image from module.... Ready to Send!

3 In the Receive File dialog box, browse to the location on your PC where the configuration file should be stored, and select Zmodem (or Zmodem with Crash Recovery) as the receiving protocol.

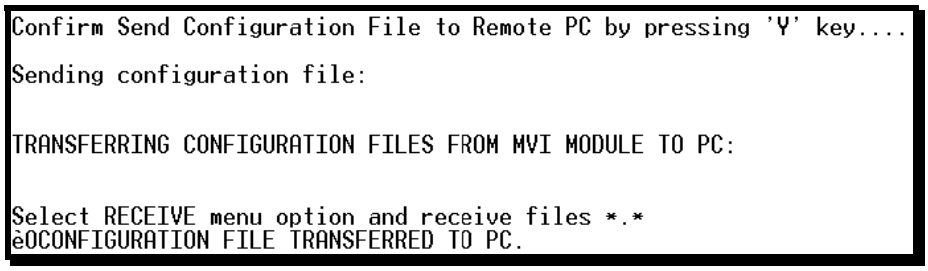


When you have completed your selections, click Close.

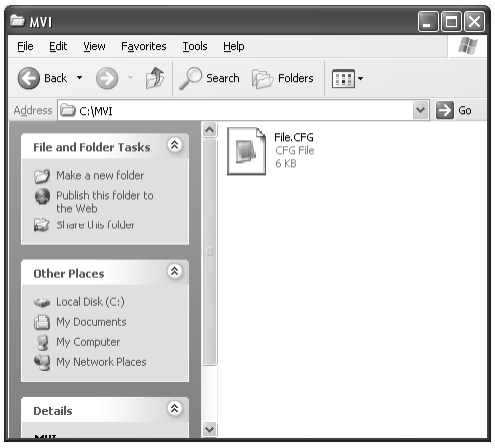
4 Press **[S]** (Send Module Configuration), and then press **[Y]** to confirm the transfer.



The file transfer will then begin automatically, using the protocol and location you specified in Step 3.
When the configuration file has been transferred to your PC, the dialog box will indicate that the transfer is complete.


Confirm Send Configuration File to Remote PC by pressing 'Y' key....
Sending configuration file:
TRANSFERRING CONFIGURATION FILES FROM MVI MODULE TO PC:
Select RECEIVE menu option and receive files *.*
èOCONFIGURATION FILE TRANSFERRED TO PC.

The configuration file is now on your PC at the location you specified.

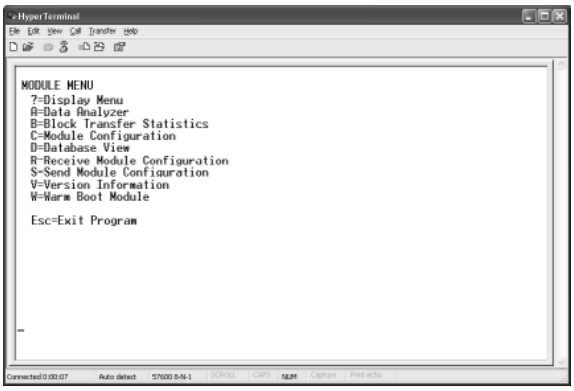


5 You can now open and edit the file in a text editor such as Notepad. When you have finished editing the file, save it and close Notepad.

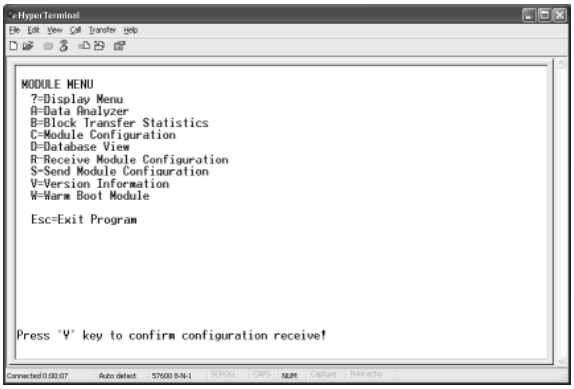
Transferring the Configuration File to the Module

Perform the following steps to transfer a configuration file from your PC to the module.

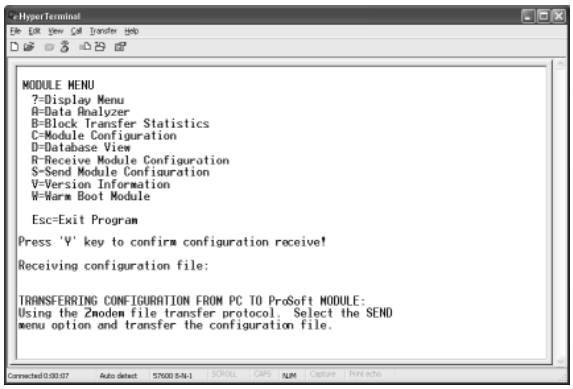
1 Connect your PC to the Configuration/Debug port of the module using a terminal program such as HyperTerminal. Press **[?]** to display the main menu.



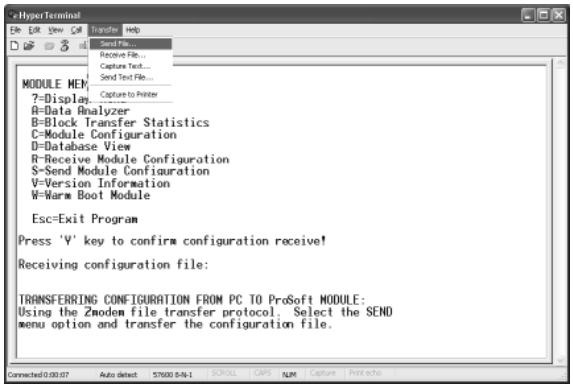
2 Press **[R]** (Receive Module Configuration). The message "Press Y key to confirm configuration receive!" is displayed at the bottom of the screen.



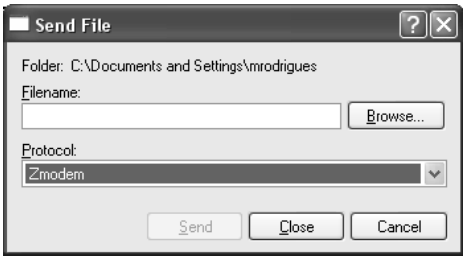
3 Press **[Y]**. The screen now indicates that the PC is ready to send.



4 From the **Transfer** menu in HyperTerminal, select **Send File**.



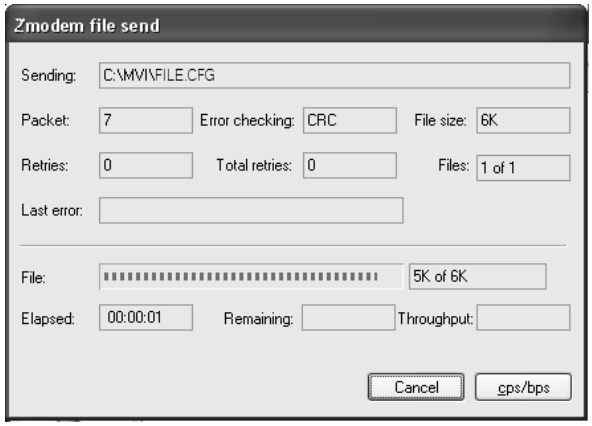
The Send File dialog appears.



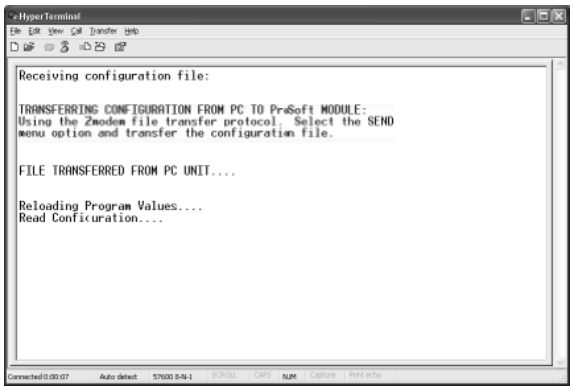
5 Use the Browse button to locate the configuration file your computer.

Note: This procedure assumes that you are uploading a newly edited configuration file from your PC to the module. However, configuration files are also available on the ProSoft CD as well as the ProSoft Technology web site.

6 Select Zmodem as the protocol.
7 Click the Send button. This action opens the Zmodem File Send dialog box.



When the upload is complete, the screen indicates that the module has reloaded program values and displays information about the module.


HyperTerminal
File Edit View Call Transfer Help
Receiving configuration file:
TRANSFERRING CONFIGURATION FROM PC TO ProSoft MODULE:
Using the Zmodem file transfer protocol, Select the SEND
menu option and transfer the configuration file.
FILE TRANSFERRED FROM PC UNIT....
Reloading Program Values....
Read Configuration....

8 Your module now contains the new configuration.

3 Ladder Logic

Ladder logic is required for application of the MVI71-HART module. Tasks that must be handled by the ladder logic are module data transfer, special block handling, and status data receipt. Additionally, a power-up handler may be needed to handle the initialization of the module's data and to clear any processor fault conditions.

The sample ladder logic, on the ProSoft Solutions CD-ROM, is extensively commented, to provide information on the purpose and function of each rung. For most applications, the sample ladder will work without modification.

4 Diagnostics and Troubleshooting

In This Chapter

- Reading Status Data from the Module 43
- LED Status Indicators 57

The module provides information on diagnostics and troubleshooting in the following forms:

- Status data values are transferred from the module to the processor
- Data contained in the module can be viewed through the Configuration/Debug port attached to a terminal emulator
- LED status indicators on the front of the module provide information on the module's status

4.1 Reading Status Data from the Module

The MVI71-HART module returns a status data set to the PLC processor in read blocks with identification codes of 0 and -1. This data is transferred to the PLC processor continuously.

The Configuration/Debug port provides the following functionality:

- Full view of the module's configuration data
- View of the module's status data
- Version Information
- Control over the module (warm boot and cold boot)
- Facility to upload and download the module's configuration file

4.1.1 The Configuration/Debug Menu

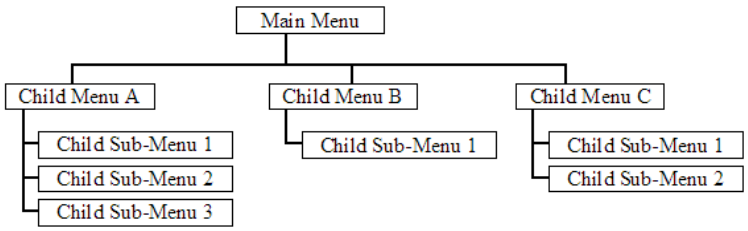
The Configuration and Debug menu for this module is arranged as a tree structure, with the Main Menu at the top of the tree, and one or more sub-menus for each menu command. The first menu you see when you connect to the module is the Main menu.

Because this is a text-based menu system, you enter commands by typing the command letter from your computer keyboard in the terminal application (for example, HyperTerminal). The module does not respond to mouse movements or clicks. The command executes as soon as you press the command letter — you do not need to press **[Enter]**. When you type a command letter, a new screen will be displayed in your terminal application.

Navigation

All of the sub-menus for this module contain commands to redisplay the menu or return to the previous menu. You can always return from a sub-menu to the next higher menu by pressing **[M]** on your keyboard.

The organization of the menu structure is represented in simplified form in the following illustration:



The remainder of this section shows you the menus available for this module, and briefly discusses the commands available to you.

Keystrokes

The keyboard commands on these menus are almost always non-case sensitive. You can enter most commands in lower case or capital letters.

The menus use a few special characters (**[?], [-], [+], [@]**) that must be entered exactly as shown. Some of these characters will require you to use the **[SHIFT], [CTRL]** or **[ALT]** keys to enter them correctly. For example, on US English keyboards, enter the **[?]** command as **[SHIFT][/].**

Also, take care to distinguish capital letter **[I]** from lower case letter **[L]** (L) and number **[1];** likewise for capital letter **[O]** and number **[0].** Although these characters look nearly the same on the screen, they perform different actions on the module.

4.1.2 Required Hardware

You can connect directly from your computer's serial port to the serial port on the module to view configuration information, perform maintenance, and send (upload) or receive (download) configuration files.

ProSoft Technology recommends the following minimum hardware to connect your computer to the module:

- 80486 based processor (Pentium preferred)
- 1 megabyte of memory
- At least one UART hardware-based serial communications port available. USB-based virtual UART systems (USB to serial port adapters) often do not function reliably, especially during binary file transfers, such as when uploading/downloading configuration files or module firmware upgrades.
- A null modem serial cable.

4.1.3 Required Software

In order to send and receive data over the serial port (COM port) on your computer to the module, you must use a communication program (terminal emulator).

A simple communication program called HyperTerminal is pre-installed with recent versions of Microsoft Windows operating systems. If you are connecting from a machine running DOS, you must obtain and install a compatible communication program. The following table lists communication programs that have been tested by ProSoft Technology.

DOS	ProComm, as well as several other terminal emulation programs
Windows 3.1	Terminal
Windows 95/98	HyperTerminal
Windows NT/2000/XP	HyperTerminal

The module uses the Zmodem file transfer protocol to send (upload) and receive (download) configuration files from your module. If you use a communication program that is not on the list above, please be sure that it supports Zmodem file transfers.

4.1.4 Using the Configuration/Debug Port

To connect to the module's Configuration/Debug port:

1. Connect your computer to the module's port using a null modem cable.
2. Start the communication program on your computer and configure the communication parameters with the following settings:

Baud Rate	57,600
Parity	None
Data Bits	8
Stop Bits	1
Software Handshaking	None

3. Open the connection. When you are connected, press the **[?]** key on your keyboard. If the system is set up properly, you will see a menu with the module name followed by a list of letters and the commands associated with them.

If there is no response from the module, follow these steps:

1. Verify that the null modem cable is connected properly between your computer's serial port and the module. A regular serial cable will not work.
2. Verify that RSLinx is not controlling the COM port. Refer to Disabling the RSLinx Driver for the Com Port on the PC (page 81).
3. Verify that your communication software is using the correct settings for baud rate, parity and handshaking.
4. On computers with more than one serial port, verify that your communication program is connected to the same port that is connected to the module.

If you are still not able to establish a connection, you can contact ProSoft Technology Technical Support for further assistance.

4.1.5 Main Menu

When you first connect to the module from your computer, your terminal screen will be blank. To activate the main menu, press the [?] key on your computer's keyboard. If the module is connected properly, the following menu will appear on your terminal screen:

```
HART COMMUNICATION MODULE MENU
  ?=Display Menu
  B=Block Transfer Statistics
  C=Module Configuration
  D=Modbus Database View
  H=HART Menu
  R=Transfer Configuration from PC to MVI Unit
  S=Transfer Configuration from MVI Unit to PC
  V=Version Information
  W=Warm Boot Module
  Esc=Exit Program
```

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the module to stop communicating with the processor or with other devices, resulting in potential data loss or other failures. Only use these commands if you are specifically directed to do so by ProSoft Technology Technical Support staff. Some of these command keys are not listed on the menu, but are active nevertheless. Please be careful when pressing keys so that you do not accidentally execute an unwanted command.

Viewing Block Transfer Statistics

Press **[B]** from the Main Menu to view the Block Transfer Statistics screen.

Use this command to display the configuration and statistics of the backplane data transfer operations between the module and the processor. The information on this screen can help determine if there are communication problems between the processor and the module.

Tip: To determine the number of blocks transferred each second, mark the numbers displayed at a specific time. Then some seconds later activate the command again. Subtract the previous numbers from the current numbers and divide by the quantity of seconds passed between the two readings.

Viewing Module Configuration

Press **[C]** to view the Module Configuration screen.

Use this command to display the current configuration and statistics for the module.

Opening the Database Menu

Press **[D]** to open the Database View menu. Use this menu command to view the current contents of the module's database.

Opening the HART Master Menu

Press **[H]** to open the HART Master Menu. This menu allows you to view information about the protocol driver.

```
HART INTERFACE MENU
  ?=Display Menu
  A=HART Data Analyzer
  V=Slave Status List
  M=Main Menu
  HART Command List Errors:
      E=Port 0   F=Port 1   G=Port 2   H=Port 3
  HART Command List:
      N=Port 0   O=Port 1   P=Port 2   Q=Port 3
  Port Status and Configuration:
      1=Port 0   2=Port 1   3=Port 2   4=Port 3
```

Transferring the Configuration File from PC to MVI71 module

Press **[S]** to send (download) the configuration file from your PC to the module and store the file on the module's Compact Flash Disk.

Press **[Y]** to confirm the file transfer, and then follow the instructions on the terminal screen to complete the file transfer process.

After the file has been successfully downloaded, the module will restart the program and load the new configuration information. Review the new configuration using menu commands **[6]** and **[0]** to verify that the module is configured correctly.

Transferring the Configuration File from MVI71 module to PC

Press **[R]** to receive (upload) the configuration file from the module to your PC.

Press **[Y]** to confirm the file transfer, and then follow the instructions on the terminal screen to complete the file transfer process.

After the file has been successfully downloaded, you can open and edit the file to change the module's configuration.

Viewing Version Information

Press **[V]** to view Version information for the module.

Use this command to view the current version of the software for the module, as well as other important values. You may be asked to provide this information when calling for technical support on the product.

Values at the bottom of the display are important in determining module operation. The Program Scan Counter value is incremented each time a module's program cycle is complete.

Tip: Repeat this command at one-second intervals to determine the frequency of program execution.

Warm Booting the Module

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the module to stop communicating with the processor or with other devices, resulting in potential data loss or other failures. Only use these commands if you are specifically directed to do so by ProSoft Technology Technical Support staff. Some of these command keys are not listed on the menu, but are active nevertheless. Please be careful when pressing keys so that you do not accidentally execute an unwanted command.

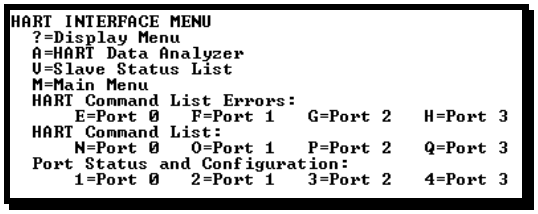
Press **[W]** from the Main Menu to warm boot (restart) the module. This command will cause the program to exit and reload, refreshing configuration parameters that must be set on program initialization. Only use this command if you must force the module to re-boot.

Exiting the Program

Caution: Some of the commands available to you from this menu are designed for advanced debugging and system testing only, and can cause the module to stop communicating with the processor or with other devices, resulting in potential data loss or other failures. Only use these commands if you are specifically directed to do so by ProSoft Technology Technical Support staff. Some of these command keys are not listed on the menu, but are active nevertheless. Please be careful when pressing keys so that you do not accidentally execute an unwanted command.

Press **[ESC]** to restart the module and force all drivers to be loaded. The module will use the configuration stored in the module's Flash memory to configure the module.

4.1.6 HART Master Menu


HART INTERFACE MENU
?=Display Menu
A=HART Data Analyzer
V=Slave Status List
M=Main Menu
HART Command List Errors:
E=Port 0 F=Port 1 G=Port 2 H=Port 3
HART Command List:
N=Port 0 O=Port 1 P=Port 2 Q=Port 3
Port Status and Configuration:
1=Port 0 2=Port 1 3=Port 2 4=Port 3

Redisplaying the Menu

Press **[?]** to display the current menu. Use this command when you are looking at a screen of data, and want to view the menu choices available to you.

Opening the Data Analyzer Menu

Press **[A]** to open the Data Analyzer Menu. Use this command to view all bytes of data transferred on each port. Both the transmitted and received data bytes are displayed. Refer to Data Analyzer (page 51) for more information about this menu.

Important: When in analyzer mode, program execution will slow down. Only use this tool during a troubleshooting session. Before disconnecting from the Config/Debug port, please press [S] to stop the data analyzer, and then press [M] to return to the main menu. This action will allow the module to resume its normal high speed operating mode.

Viewing the Slave Status List

Press **[V]** to view the slave status values associated with the ports. The slave status values are defined as follows:

- ERR = Device in Error
- OK = Device OK
- [Blank] = Device Not Polled.

Opening the Command Error List Menu

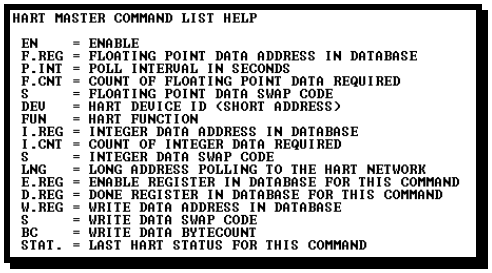
Press **[E], [F], [G]** or **[H]** to open the Command Error List for clients 1 through 4 respectively. This list consists of multiple pages of command list error/status data. Press **[?]** to view a list of commands available on this menu.

Opening the Command List Menu

Press **[N], [O], [P]** or **[Q]** to open the Command List menu for clients 1 through 4 respectively. Use this command to view the configured command list for the module.

Viewing the Master Command List Help

Press **[H]** to view a help screen with explanations of each item that appears on the command list.


HART MASTER COMMAND LIST HELP
EN = ENABLE
F.REG = FLOATING POINT DATA ADDRESS IN DATABASE
P.INT = POLL INTERVAL IN SECONDS
F.CNT = COUNT OF FLOATING POINT DATA REQUIRED
S = FLOATING POINT DATA SWAP CODE
DEV = HART DEVICE ID (SHORT ADDRESS)
FUN = HART FUNCTION
I.REG = INTEGER DATA ADDRESS IN DATABASE
I.CNT = COUNT OF INTEGER DATA REQUIRED
S = INTEGER DATA SWAP CODE
LNG = LONG ADDRESS POLLING TO THE HART NETWORK
E.REG = ENABLE REGISTER IN DATABASE FOR THIS COMMAND
D.REG = DONE REGISTER IN DATABASE FOR THIS COMMAND
W.REG = WRITE DATA ADDRESS IN DATABASE
S = WRITE DATA SWAP CODE
BC = WRITE DATA BYTECOUNT
STAT. = LAST HART STATUS FOR THIS COMMAND

Viewing Port Status and Configuration

Press **[1], [2], [3],** or **[4]** to view status and configuration for ports 0 through 3 respectively.

HART Error Descriptions

Error Type	Description
Gap Errors	Increments when a delay of more than 20 milliseconds occurs between characters in a HART message
Overflow	Increments when a received HART message is longer than the internal buffer can hold
SOM Errors	**Start of Message** error - Increments whenever the module does not see at least 3 preambles (FF characters or all bits set ON) at the beginning of a HART message
Retry Count	Increments every time a HART command fails and is retried
Check Byte	Increments when a Checksum error is detected in the received HART packet.
Overrun/Parity/Frame	Increments every time one of three errors occur: **Overrun** - The HART driver wasn't able to read the current data byte before a new one arrived, causing the current character to be lost. **Parity -** HART communications uses EVEN parity. A byte is received with parity error. **Frame** - There is a zero bit where the stop bit should be. The message is not formatted correctly. These errors are typically caused by electrical wiring problems or electrical interference on the network loop.
Response Timeout	Increments when the response to a HART Command is not received within the configured timeout period.

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.1.7 Data Analyzer

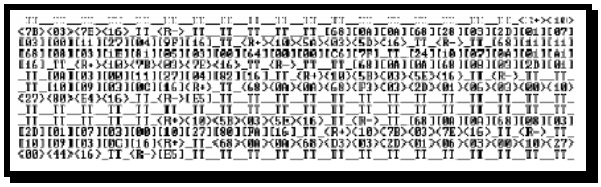
The data analyzer mode allows you to view all bytes of data transferred on each port. Both the transmitted and received data bytes are displayed. Use of this feature is limited without a thorough understanding of the protocol.

```
HART DATA ANALYZER VIEW MENU
 ?=Display Menu
 1=Select HART Port 0
 2=Select HART Port 1
 3=Select HART Port 2
 4=Select HART Port 3
 C=1 mSec Ticks
 D=5 mSec Ticks
 E=10 mSec Ticks
 F=50 mSec Ticks
 G=100 mSec Ticks
 0=No mSec Ticks
 H=Hex Format
 A=ASCII Format
 B=Start
 S=Stop
 Z=HART Menu

 Port = HART PORT 0, Format=HEX, Tick=0
```

Important: When in analyzer mode, program execution will slow down. Only use this tool during a trouble-shooting session. Before disconnecting from the Config/Debug port, please be sure to press [M] to return to the main menu and disable the data analyzer. This action will allow the module to resume its normal operating mode.

Analyzing Data for Port 1

Press **[1]** to display I/O data for Port 1 in the Data Analyzer. The following illustration shows an example of the Data Analyzer output.



Displaying Timing Marks in the Data Analyzer

You can display timing marks for a variety of intervals in the data analyzer screen. These timing marks can help you determine communication-timing characteristics.

Key	Interval
[5]	1 milliseconds ticks
[6]	5 milliseconds ticks
[7]	10 milliseconds ticks
[8]	50 milliseconds ticks

Key	Interval
[9]	100 milliseconds ticks
[0]	Turn off timing marks

Removing Timing Marks in the Data Analyzer

Press **[0]** to turn off timing marks in the Data Analyzer screen.

Viewing Data in Hexadecimal Format

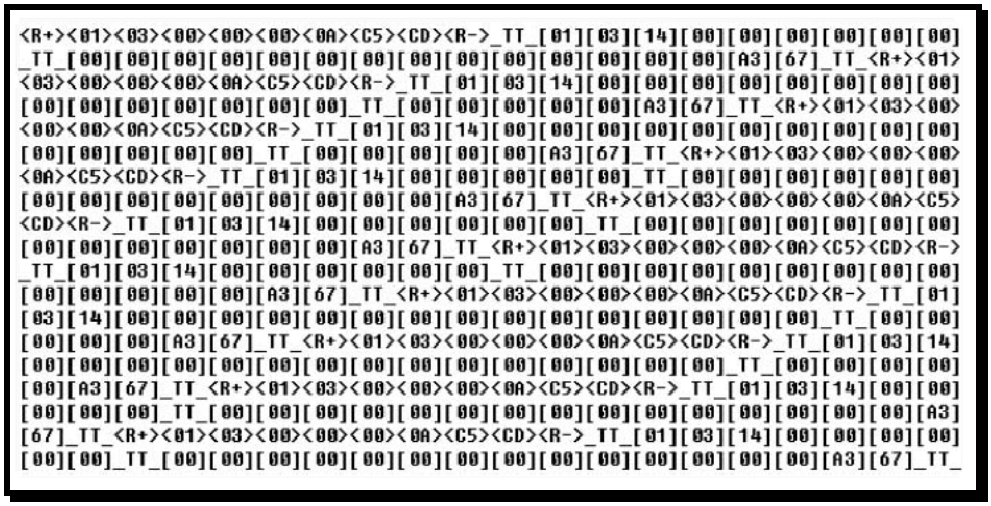
Press **[H]** to display the data on the current page in hexadecimal format.

Viewing Data in ASCII (Text) Format

Press **[A]** to display the data on the current page in ASCII format. This is useful for regions of the database that contain ASCII data.

Starting the Data Analyzer

Press **[B]** to start the data analyzer. After the key is pressed, all data transmitted and received on the currently selected port will be displayed. The following illustration shows an example.



The Data Analyzer displays the following special characters:

Character	Definition
[ ]	Data enclosed in these characters represent data received on the port.
< >	Data enclosed in these characters represent data transmitted on the port.
<R+>	These characters are inserted when the RTS line is driven high on the port.
<R->	These characters are inserted when the RTS line is dropped low on the port.
<CS>	These characters are displayed when the CTS line is recognized high.
_TT_	These characters are displayed when the timing mark interval has been reached. This parameter is user defined.

Stopping the Data Analyzer

Press **[S]** to stop the data analyzer. Use this option to freeze the display so the data can be analyzed. To restart the analyzer, press **[B].**

Important: When in analyzer mode, program execution will slow down. Only use this tool during a troubleshooting session. Before disconnecting from the Config/Debug port, please press [S] to stop the data analyzer, and then press [M] to return to the main menu. This action will allow the module to resume its normal high speed operating mode.

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.1.8 Data Analyzer Tips

From the main menu, press **[A]** for the "Data Analyzer". You should see the following text appear on the screen:

```
Data Analyzer Mode Selected
```

After the "Data Analyzer" mode has been selected, press **[?]** to view the Data Analyzer menu. You will see the following menu:

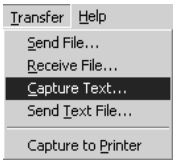
```
DATA ANALYZER VIEW MENU
 ?=Display Menu
 1=Select Port 1
 2=Select Port 2
 5=1 mSec Ticks
 6=5 mSec Ticks
 7=10 mSec Ticks
 8=50 mSec Ticks
 9=100 mSec Ticks
 0=No mSec Ticks
 H=Hex Format
 A=ASCII Format
 B=Start
 S=Stop
 M=Main Menu

 Port = 1, Format=HEX, Tick=10
```

From this menu, you can select the "Port", the "format", and the "ticks" that you can display the data in.

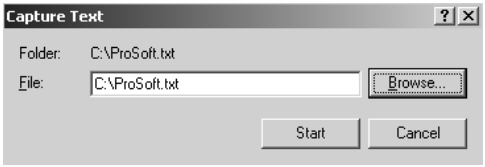
For most applications, HEX is the best format to view the data, and this does include ASCII based messages (because some characters will not display on HyperTerminal and by capturing the data in HEX, we can figure out what the corresponding ASCII characters are supposed to be).

The Tick value is a timing mark. The module will print a _TT for every xx milliseconds of no data on the line. Usually 10milliseconds is the best value to start with.

After you have selected the Port, Format, and Tick, we are now ready to start a capture of this data. The easiest way to do so is to go up to the top of you HyperTerminal window, and do a **TRANSFER / CAPTURE TEXT** as shown below:



After selecting the above option, the following window will appear:



Next name the file, and select a directory to store the file in. In this example, we are creating a file ProSoft.txt and storing this file on our root C: drive. After you have done this, press the Start button.

Now you have everything that shows up on the HyperTerminal screen being logged to a file called ProSoft.txt. This is the file that you will then be able to email to ProSoft Technical Support to assist with issues on the communications network.

To begin the display of the communications data, you will then want to press **[B]** to tell the module to start printing the communications traffic out on the debug port of the module. After you have pressed **[B],** you should see something like the following:

```
[03][00][04][00][05][00][06][00][07][00][08][00][09][FB][B7]_TT__TT_<R+><01><02>
<00><00><00><0A><F8><0D><R->_TT__TT__TT_[01][02][02][00][00]B9][B8]_TT__TT_<R+>
<01><03><00><00><00><0A><C5><CD><R->_TT__TT_[01][03][14][00][00][00][01][00]_TT_
[02][00][03][00][04][00][05][00][06][00][07][00][08][00][09][CD][51]_TT__TT_<R+>
<01><01><00><00><00><A0><3C><72><R->_TT__TT_[01][01][14][00][00][01][00][02]_TT_
[00][03][00][04][00][05][00][06][00][07][00][08][00][09][00][B7][52]_TT__TT_<R+>
<01><04><00><00><00><0A><70><0D><R->_TT__TT_[01][04][14][00][00][00][01][00]_TT_
[02][00][03][00][04][00][05][00][06][00][07][00][08][00][09][FB][B7]_TT__TT_<R+>
<01><02><00><00><00><0A><F8><0D><R->_TT__TT__TT_[01][02][02][00][00]B9][B8]_TT_
_TT_<R+><01><03><00><00><00><0A><C5><CD><R->_TT__TT_[01][03][14][00][00][00][01]
[00]_TT_[02][00][03][00][04][00][05][00][06][00][07][00][08][00][09][CD][51]_TT_
_TT_<R+><01><01><00><00><00><A0><3C><72><R->_TT__TT__TT_[01][01][14][00][00][01]
[00][02]_TT_[00][03][00][04][00][05][00][06][00][07][00][08][00][09][00][B7][52]
_TT__TT_<R+><01><04><00><00><00><0A><70><0D><R->_TT__TT_[01][04][14][00][00][00]
[01][00]_TT_[02][00][03][00][04][00][05][00][06][00][07][00][08][00][09][FB][B7]
_TT__TT_<R+><01><02><00><00><00><0A><F8><0D><R->_TT__TT_[01][02][02][00][00][B9]
[B8]_TT__TT_<R+><01><03><00><00><00><0A><C5><CD><R->_TT__TT_[01][03][14][00][00]
[00][01][00]_TT_[02][00][03][00][04][00][05][00][06][00][07][00][08][00][09][CD]
[51]_TT__TT_<R+><01><01><00><00><00><A0><3C><72><R->_TT__TT__TT_[01][01][14][00]
[00][01][00][02]_TT_[00][03][00][04][00][05][00][06][00][07][00][08][00][09][00]
[B7][52]_TT__TT_<R+><01><04><00><00><00><0A><70><0D><R->_TT__TT_[01][04][14][00]
[00][00][01][00]_TT_[02][00][03][00][04][00][05][00][06][00][07][00][08][00][09]
[FB][B7]_TT__TT_<R+><01><02><00><00><00><0A><F8><0D><R->_TT__TT__TT_[01][02][02]
[00][00][B9][B8]_TT__TT_<R+><01><03><00><00><00><0A><C5><CD><R->_TT__TT_
```

The <R+> means that the module is transitioning the communications line to a transmit state.

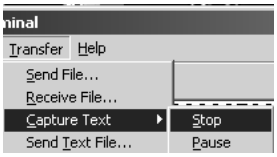
All characters shown in <> brackets are characters being sent out by the module.

The <R-> shows when the module is done transmitting data, and is now ready to receive information back.

And finally, all characters shown in the [ ] brackets is information being received from another device by the module.

After taking a minute or two of traffic capture, you will now want to stop the "Data Analyzer". To do so, press the [S] key, and you will then see the scrolling of the data stop.

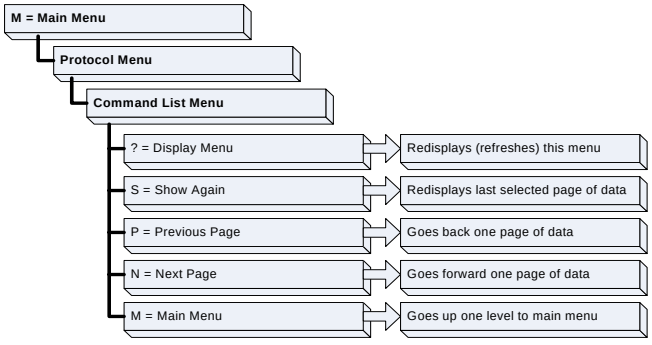
When you have captured the data you want to save, open the Transfer menu and choose Capture Text. On the secondary menu, choose Stop.



You have now captured, and saved the file to your PC. This file can now be used in analyzing the communications traffic on the line, and assist in determining communication errors.

4.1.9 Master Command Error List Menu

Use this menu to view the command error list for the module. Press **[?]** to view a list of commands available on this menu.


M = Main Menu
Protocol Menu
Command List Menu
? = Display Menu
Redisplays (refreshes) this menu
S = Show Again
Redisplays last selected page of data
P = Previous Page
Goes back one page of data
N = Next Page
Goes forward one page of data
M = Main Menu
Goes up one level to main menu

Redisplaying the Current Page

Press **[S]** to display the current page of data.

Viewing the Previous 20 Commands

Press **[-]** to display data for the previous 20 commands.

Viewing the Previous Page of Commands

Press **[P]** to display the previous page of commands.

Viewing the Next 20 Commands

Press **[+]** to display data for the next 20 commands.

Viewing the Next Page of Commands

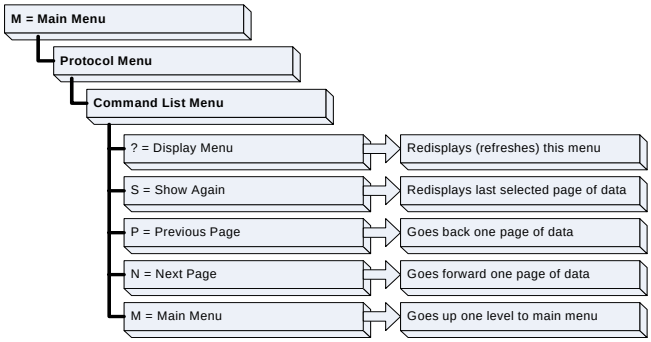
Press **[N]** to display the next page of commands.

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.1.10 Master Command List Menu

Use this menu to view the command list for the module. Press **[?]** to view a list of commands available on this menu.


M = Main Menu
Protocol Menu
Command List Menu
? = Display Menu
Redisplays (refreshes) this menu
S = Show Again
Redisplays last selected page of data
P = Previous Page
Goes back one page of data
N = Next Page
Goes forward one page of data
M = Main Menu
Goes up one level to main menu

Redisplaying the Current Page

Press **[S]** to display the current page of data.

Viewing the Previous 50 Commands

Press **[-]** to view the previous 50 commands.

Viewing the Previous Page of Commands

Press **[P]** to display the previous page of commands.

Viewing the Next 50 Commands

Press **[+]** to view the next 50 commands from the master command list.

Viewing the Next Page of Commands

Press **[N]** to display the next page of commands.

Returning to the Main Menu

Press **[M]** to return to the Main Menu.

4.2 LED Status Indicators

The LEDs indicate the module's operating status as follows:

Module	Color	Status	Indication
CFG	Green	On	NA
		Off	NA
P1	Green	On	NA
		Off	NA
P2	Green	On	Data is being transferred between the module and a remote terminal using the Configuration/Debug port.
		Off	No data is being transferred on the Configuration/Debug port.
APP Status	Amber	Off	The MVI71-HART is working normally.
		On	The MVI71-HART module program has recognized a communication error.
BP ACT	Amber	On	The LED is on when the module is performing a write operation on the backplane.
		Off	The LED is off when the module is performing a read operation on the backplane. Under normal operation, the LED should blink rapidly on and off.
OK	Red/ Green	Off	The card is not receiving any power and is not securely plugged into the rack.
		Green	The module is operating normally.
		Red	The program has detected an error or is being configured. If the LED remains red for over 10 seconds, the program has probably halted. Remove the card from the rack and re-insert the card to restart the module's program.
BAT	Red	Off	The battery voltage is OK and functioning.
		On	The battery voltage is low or battery is not present. Allow battery to charge by keeping module plugged into rack for 24 hours. If BAT LED still does not go off, contact ProSoft Technology, as this is not a user serviceable item.

4.2.1 Clearing a Fault Condition

Typically, if the OK LED on the front of the module turns red for more than ten seconds, a hardware problem has been detected in the module, or the program has exited.

To clear the condition, follow these steps:

1. Turn off power to the rack
2. Remove the card from the rack
3. Verify that all jumpers are set correctly
4. If the module requires a Compact Flash card, verify that the card is installed correctly
5. Re-insert the card in the rack and turn the power back on
6. Verify the configuration data being transferred to the module from the PLC processor.

If the module's OK LED does not turn green, verify that the module is inserted completely into the rack. If this does not cure the problem, contact ProSoft Technology Support.

4.2.2 Troubleshooting

Use the following troubleshooting steps if you encounter problems when the module is powered up. If these steps do not resolve your problem, please contact ProSoft Technology Technical Support.

Processor Errors

Problem Description	Steps to take
Processor Fault	Verify that the module is plugged into the slot that has been configured for the module. Verify that the slot location in the rack has been configured correctly in the ladder logic.
Processor I/O LED flashes	This indicates a problem with backplane communications. Verify that all modules in the rack are configured in the ladder logic.

Module Errors

Problem Description	Steps to take
BP ACT LED remains off or blinks slowly	This indicates that backplane transfer operations are failing. Connect to the module's Configuration/Debug port to check this.
MVI56E modules with scrolling LED display: <Backplane Status> condition reads ERR	To establish backplane communications, verify the following items: ▪ The processor is in Run mode. ▪ The backplane driver is loaded in the module. ▪ The module is configured for read and write block data transfer. ▪ The ladder logic handles all read and write block situations. ▪ The module is configured in the processor.
OK LED remains red	The program has halted or a critical error has occurred. Connect to the Configuration/Debug port to see if the module is running. If the program has halted, turn off power to the rack, remove the card from the rack and re-insert the card in the rack, and then restore power to the rack.

5 Reference

In This Chapter

- Product Specifications 59
- Functional Overview 61
- RS-232 Configuration/Debug Port 81
- DB9 to RJ45 Adaptor (Cable 14) 83
- Application Port Connection 84
- Example Field Terminations 84
- MVI71-HART Status Data Area and Error Codes 92
- HART Universal Commands 98
- HART Common Practice Commands 111

5.1 Product Specifications

The MVI71 HART Multi-drop Master Communication Module is an PLC backplane-compatible module that allows PLC processors to interface easily with HART compatible devices. Devices commonly supporting the protocol include pressure, temperature, flow transmitters, as well as other similar instruments commonly found in the process (and other) industry.

The MVI71-HART Master Communication Module allows Rockwell Automation PLC compatible processors to easily communicate with HART slave devices. The MVI71-HART module interfaces up to 15 devices on each HART channel with the PLC processor. Four channels on the module support master protocol commands to interface with slave devices on their own networks. Each port is individually configurable. Data is exchanged between the HART network and the PLC processor backplane using the internal database contained in the module and direct control by the processor's ladder logic and pre-defined data objects (5000 registers maximum).

The MVI71-HART module is the perfect solution for industrial applications in chemical and refining operations, to gas and liquid distribution systems, and remote offshore monitoring stations are addressing virtually all aspects of control, data acquisition, and maintenance.

HART® is a registered trademark of the HART Communication Foundation

5.1.1 General Specifications

- Single Slot - 1771 backplane compatible
- The module is recognized as an Input/Output module and has access to processor memory for data transfer between processor and module
- Ladder Logic is used for data transfer between module and processor. Sample ladder file included.
- Configuration data obtained from configuration text file downloaded to module. Sample configuration file included.

5.1.2 Hardware Specifications

Specification	Description
Form Factor	Single Slot 1771 chassis compatible BTR/BTW data transfer Local or remote rack
Backplane current load	800 mA @ 5 V
Operating temperature	0 to 60°C (32 to 140°F)
Storage temperature	-40 to 85°C (-40 to 185°F)
Shock	30g operational 50g non-operational
Vibration	5 g from 10150 Hz
Relative humidity	5% to 95% (non-condensing)
LED Indicators	Module status Backplane transfer status Application status Serial activity and error LED status
Debug/Configuration port (CFG)	
CFG Port (P1)	RJ45 (DB-9M with supplied cable) RS-232 only
Configuration Connector	RJ45 RS-232 Connector (RJ45 to DB-9 cable shipped with unit)
Application Ports	
Application Serial port (P2, P3) (Serial Modules)	Two RJ45 RS-232/422/485 Application ports

5.1.3 Functional Specifications

The MVI71-HART module supports the HART Multi-drop implementation of the protocol. Following are some general specifications for the module:

- Built in accordance to the HART Bell 202 Frequency Shift Keying (FSK) standard to superimpose digital signals at a low level on top of the 4 to 20mA
  - Four independent HART master ports that are completely user-configurable
  - Supports up to 15 devices per port
  - Point-to-point (slave address 0) or Multi-drop (slave address 1 to 15) modes supported

- Supports 99 universal and common practice commands per port to control and monitor devices with integer, IEEE754 floating-point and packed ASCII character string data blocks
- Burst mode can be used for faster update of data from a single slave
- Supports an auto polling feature that will automatically collect data from each HART instrument on the channel and store the data in the module database
- Communication ports can be configured as a secondary master (that is, handheld configuration device)

Protocol Supported: HART protocol uses the Bell 202 standard frequency shift-keying (FSK) digital signal to communicate at 1200 baud, superimposed at a low level on the 4 to 20mA analog measurement signal. The MVI71-HART module supports version 5 of the HART protocol.

Supported Function Codes: HART Universal Commands Set supported are 00 to 03, 06 to 09, and 11 to 22. HART Common Practice Commands Set supported are 33 to 83 and 105 to 110.

HART Network Communications: Supports four master channels. Each channel on the module is configured independently to emulate a HART master. Burst mode can be used for faster update of data from a slave device.

Command polling is also user-configurable, including disabled, continuous, on change of data (write only), and dynamically user or automatic enabled.

Status: Error codes returned by the HART protocol available on an individual command basis. In addition, a slave status list is maintained per active channel.

5.2 Functional Overview

This section provides an overview of how the MVI71-HART module transfers data between itself and the processor and how it implements the Modbus protocol. You should understand the important concepts in this chapter before you begin installing and configuring the module.

5.2.1 General Concepts

The following discussion explains several concepts that are important for understanding the operation of the MVI71-HART module.

Module Power Up

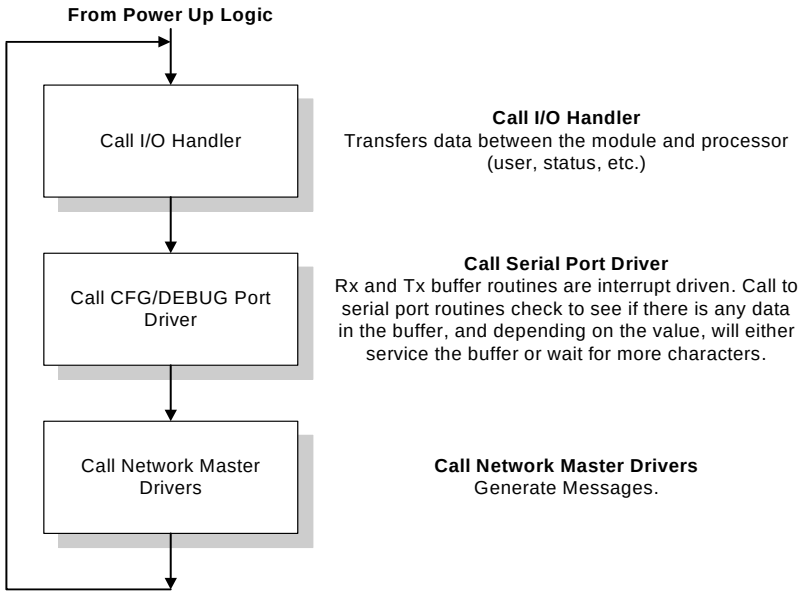
On power up, the module begins performing the following logical functions:

1. Initialize hardware components
   - Initialize PLC backplane driver
   - Test and clear all RAM
   - Initialize the serial communication ports
2. Read configuration for module from HART.CFG file on Compact Flash Disk
3. Initialize the databases and ports
4. Set up the communication interface for the debug/configuration port

After the module has received the configuration, the module begins receiving and transmitting messages with devices on the serial networks.

Main Logic Loop

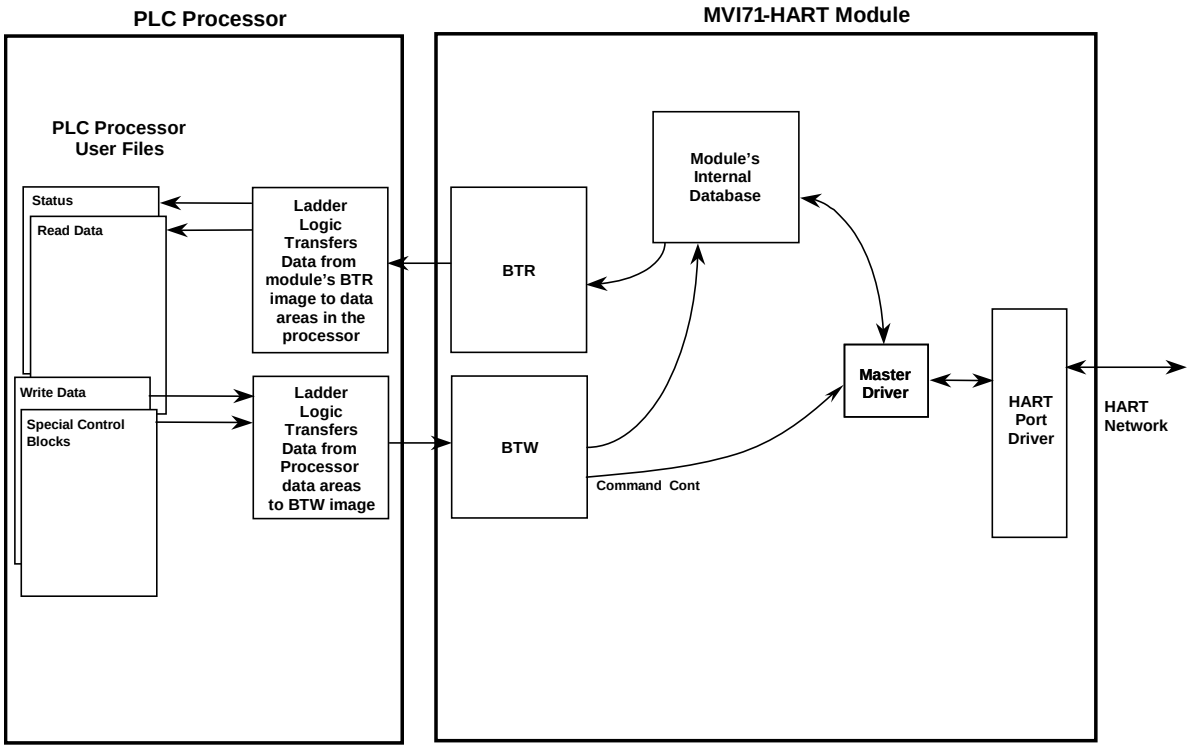
Upon completing the power up configuration process, the module enters an infinite loop that performs the following functions:


From Power Up Logic
Call I/O Handler
Call I/O Handler
Transfers data between the module and processor (user, status, etc.)
Call CFG/DEBUG Port Driver
Call Serial Port Driver
Rx and Tx buffer routines are interrupt driven. Call to serial port routines check to see if there is any data in the buffer, and depending on the value, will either service the buffer or wait for more characters.
Call Network Master Drivers
Call Network Master Drivers
Generate Messages.

5.2.2 Backplane Data Transfer

The MVI71-HART module communicates directly over the PLC backplane for the block transfer interface. Data is paged between the module and the PLC processor across the backplane using BTR and BTW operations. Data is transferred from the module to the processor using the BTR blocks, and data is transferred from the processor to the module using the BTW blocks.

The following illustration shows the data transfer method used to move data between the PLC processor, the MVI71-HART module and the serial network.



All data transferred between the module and the processor over the backplane is through the BTR and BTW blocks. Ladder logic must be written in the PLC processor to interface the block data with user data files. All data used by the module is stored in its internal database.

Data contained in this database is paged through the block transfer interface by coordination of the PLC ladder logic and the MVI71-HART module's program. Up to 64 words of data can be transferred from the module to the processor at a time. Up to 64 words of data can be transferred from the processor to the module. The read and write block identification codes in each data block determine the function to be performed or the content of the data block.

Block ID	Descriptions
-1	Null block (Status Data Only)
0	Null block (Status Data Only)
1 to 67	Read or write data
1000 to 1067	Output Data Initialization Request
9902	Command Enable Control Block
9903	Command Disable Control Block
9950	Command List Error data
9998	Warm Boot Request from PLC (Block contains no data)
9999	Cold Boot Request from PLC (Block contains no data)

These block identification codes can be broken down into two groups: Normal data transfer blocks (-1 to 67) and Command control blocks (9902 to 9999). Each of these groups of blocks are discussed in the following topics.

Blocks -1 and 0 transfer status data from the module to the processor and they contain no data when transferred from the processor to the module. Blocks 1 to 67 are utilized to transfer data stored or to be stored in the module's database. These data blocks send data from module to the processor (monitored data received from the devices on the serial network) and to send data from the processor to the module (control data to send to the end devices). Block identification codes 1000 to 9999 are used for special control blocks to control the module.

Backplane Application Example

This section shows an example of how the backplane communication is performed between the module and the processor.

For example, if a user configures the backplane section in the configuration file as follows:

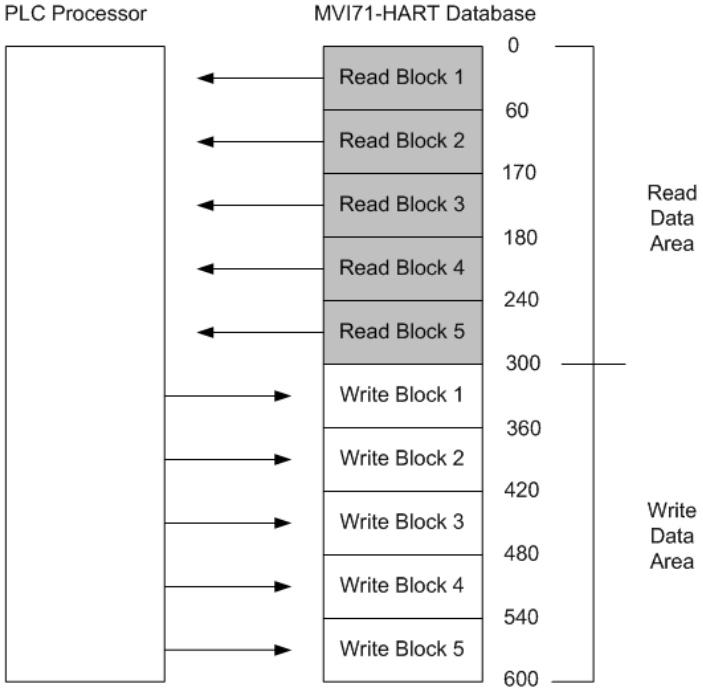
Read Register Start: 0

Read Register Count: 300

Write Register Start: 300

Write Register Count: 300

The configuration would set up the following backplane usage:



5.2.3 Normal Data Transfer

Normal data transfer includes the transferring of data received by, or to be transmitted to, the master drivers and the status data. These data are transferred through read and write blocks. Refer to Module Configuration for a description of the data objects used with the blocks and the ladder logic required. The following topics discuss the structure and function of each block.

Read Block

These blocks of data transfer information from the module to the PLC processor. The structure of the input image used to transfer data received from the HART devices is shown in the following table.

Offset	Description	Length
0	Read Block ID	1
1	Write Block ID	1
2 to 61	Read Data	60
62 to 63	Spare	2

The Block Identification Code (word 0) signals the PLC processor that a new block is ready for processing and informs the processor of the contents of the block. If the value of the code is set to 1, the block contains the first 60 words of data contained in the database of the module.

If the Read Block ID is set to 0 or -1, the block contains the status data that should be copied to the status data area in the module. This information can be used to determine the "health" and activity of the module. Refer to MVI71-HART Status Data Area and Error Codes (page 92) for a detailed listing of the area and its contents.

The normal read data block also contains the block identification code the module expects to receive from the processor (word 1 in the block). Under normal data transfer conditions, the ladder logic should use the code to build the appropriate block for the module in the output image.

Write Block

These blocks of data transfer information from the PLC processor to the module. The structure of the output image used to transfer this data is shown in the following table.

Offset	Description	Length
0	Write Block ID	1
1 to 60	Write Data	60
61 to 63	Spare	3

The Block Identification code defines the content of the data contained in the block. If the code is set to -1 or 0, the data area contains no valid data. If the word contains a value from 1 to 20, the data contained in the block should be placed in the appropriate position of the module's database. Under normal conditions, the value used for the write block identification code should be that received in the read block from the module.

5.2.4 Command Control Blocks

Block identification codes greater than or equal to 1000 are utilized to perform special functions in the module. Each control block recognized and used by the module is defined in the following topics.

Initialize Output Data

When the module performs a restart operation, it may request output data from the processor to initialize the module's read data area. Use the **Initialize Output Data** parameter in the configuration file to bring the module to a known state after a restart operation. The structure of the block used to request the data is shown in the following table.

Block Request

Offset	Description	Length
0	1000 to 1066	1
1	1000 to 1066	1
2 to 63	Not Used	62

The command value of 1000 is moved as the Block Transfer Write ID to indicate that the module is requesting initialization of the Read Data area. Ladder logic in the processor must recognize this command and place the correct information in the database. The format of the returned write block is as shown in the following table.

Block Response

Offset	Description	Length
0	1000 to 1066	1
1 to 60	Data to place in database	60
61 to 63	Not Used	3

For example, for a Read Data Area of 2 blocks (120 words), blocks 1000 and 1001 would be used.

Command Enable Control Block (9902)

The block 9902 identification code is used by the processor to enable a set of commands that have their enable code set to 4 or 5 (one shot). The value referenced by the address associated with the command, Enable DB Address, will be set to -1 to enable the command for a one-shot (enable code 5) or continuous (enable code 4) execution. After the command is executed, the module resets the register to 0 to disable the command for the one-shot mode. The format for this command block is shown in the following table.

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the value of 9902 identifying the enable command to the module.
1	Port Number	This is the HART port number (0 to 3) to be used with the command. Each port has its own command list.
2	Command count	This field contains the number of commands to enable in the command list. Valid values for this field are 1 to 60.
3 to 62	Command Numbers to enable	These 60 words of data contain the command numbers in the command list to enable. The command index starts at 1. The value referenced by the Enable DB address associated with each command will be set to -1.
63	Spare	Not Used

There is no response to this block by the module. The module will place the selected commands into the command queue. If the command references a unit that is not defined, the command will not be placed in the command queue. Normal processing of the command list will continue after the commands specified in this block are processed.

Command Disable Control Block (9903)

The block 9903 identification code is used by the processor to disable a set of commands that have an enable code set to 4 or 5 (one shot). The value referenced by the address associated with the command, Enable DB Address, will be set to 0 to disable the command. The format for this command block is shown in the following table.

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the value of 9903 identifying the enable command to the module.
1	Port Number	This is the HART port number (0 to 3) to be used with the command. Each port has its own command list.
2	Command count	This field contains the number of commands to disable in the command list. Valid values for this field are 1 to 60.
3 to 62	Command Numbers to enable	These 60 words of data contain the command numbers in the command list to disable. The command index starts at 1. The value referenced by the Enable DB address associated with each command will be set to 0.
63	Spare	Not Used

There is no response to this block by the module. The module will place the selected commands into the command queue. If the command references a unit that is not defined, the command will not be placed in the command queue. Normal processing of the command list will continue after the commands specified in this block are processed.

Command List Error/Status Data Block (9950)

Block 9950 identification code requests the Command List Error/Status Table for a single port from the module for the 99 user configurable commands. The format for the block is shown in the following table.

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the value of 9950 identifying the block type to the module.
1	Port Number	This field contains the port number to report in the response block. Valid values are 0 to 3 for ports 0 to 3 on the module.
2	Number of Commands to report	This field contains the number of commands to report in the response message. The value has a range of 1 to 50. This number must not be greater that the "command count" value configured in the configuration file.
3	Start Index of First Command	This parameter sets the index in the command list where to start. The first command in the list has a value of 0. The last index in the list has a value of MaxCommands - 1.
4 to 63	Spare	Not Used

Response to a block 9950 request: The module will respond to a valid request with a block containing the requested error information. The format for the block is shown in the following example:

Word Offset in Block	Data Field(s)	Description
0	Block ID	This field contains the value of 9950 identifying the block type to the PLC.
1	Block ID	This is the next block requested by the module.
2	Port Number	This field contains the port number (0 to 3) corresponding to the data contained in the block.
3	Number of Commands reported	This field contains the number of commands contained in the block that must be processed by the PLC. This field will have a value of 1 to 50.
4	Start Index of First Command	This field contains the index in the command list for the first value in the file. This field will have a value of 1 to MaxCommands-1.
5 to 54	Command List Errors	Each word of this area contains the last error value recorded for the command. The command index of the first value (offset 4) is specified in word 3 of the request block. The number of valid command errors in the block is set in word 3 of the block. Refer to the command error list to interpret the error codes reported.
55 to 63	Spare	Not Used

Warm Boot Block (9998)

Block 9998 performs a warm-boot operation on the module. The format of the block constructed by the processor is as follows:

Offset	Description	Length
0	9998	1
1 to 247	Spare	247

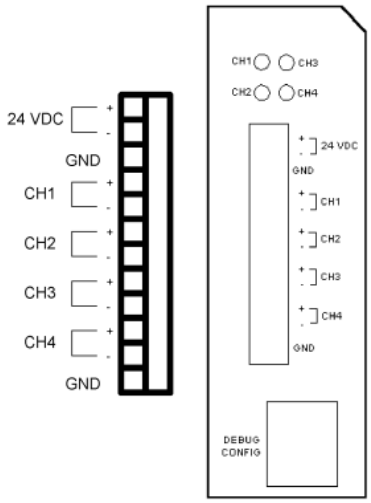
Cold Boot Block (9999)

Block 9999 performs a cold-boot operation on the module. The format of the block constructed by the processor is as follows:

Offset	Description	Length
0	9999	1
1 to 247	Spare	247

5.2.5 HART Channels

The MVI71-HART module supports the HART protocol as a Master on up to 4 channels. Each channel is individually configurable.



The relationship between the port labeling on the front of the module and the application is as follows:

Port Label	Function
P3	Debug/Configuration
CHANNEL 1	HART Port 0
CHANNEL 2	HART Port 1
CHANNEL 3	HART Port 2
CHANNEL 4	HART Port 3

The HART protocol uses the Bell 202 standard frequency shift-keying (FSK) signal to communicate at 1200 baud, superimposed at a low level on the 4 to 20 mA analog measurement signal. Having an average value of zero, an FSK signal causes no interference with the analog value. The HART devices are powered from this 4 to 20 mA analog loop.

All HART protocol channels in the module generate the Bell 202 FSK signal to communicate in multi-drop mode with up to 15 HART devices and provide up to 250 mA supply for the analog loop.

Channel Modes

Each HART channel can be set to operate in three different modes:

- User Mode
- Multi-drop
- Point-to-Point

Using the configuration file, choose the auto-poll mode through the Auto-Poll Code parameter (P, M or N). In the first two modes, the module will automatically collect data from each HART instrument on the channel (auto-poll) and store the data in the module's database.

In User Mode, the module will only execute the commands in the user command list and will not automatically acquire data. Refer to the Auto-Polling section for more information.

Mode	Use Auto-Poll	Use Command List
N (None)	N	Y
M (Multi-drop)	Y	Y
P (Point to Point)	Y	Y

When configured for Point-to-Point communication, the channel will automatically poll data from the connected slave address 0.

When configured for Multi-drop, the channel will automatically poll data from the connected slaves in the network (address 1 to 15). The user may configure the maximum slave addresses to be polled. Refer to the Auto-Polling section for more information about auto-poll mode.

User-configured commands can be issued on each channel to the HART devices. Up to 99 commands can be defined for each port. Data read from the devices is placed in the virtual database of the module, which is passed between the module and the processor.

Any write requests or device-specific commands for the HART slave devices are sourced with data from the database. Within the commands, it can be specified whether or not to use the HART device's short or long address. If the long address is selected, the device is polled first with short address to ask for the long one. Then, the device is polled with the long address. The module does all this processing of the address automatically.

In a HART network, it is possible to have two masters. The MVI71-HART module fully supports the existence of a second master, but it can reduce the throughput on the HART network. This facility is enabled or disabled in the module's configuration. If the ability to have a second master on the network is disabled, then the maximum communication throughput is achieved.

Auto-Poll Modes

Each HART channel can be set to operate in three different modes:

- Point-to-Point
- Multi-drop
- User Mode

Using the configuration file, choose the auto-poll mode through the Auto-Poll Code parameter (P, M, or N). In the first two modes, the module will automatically collect data from each HART instrument on the channel (auto-poll) and store the data in the module's database.

In User Mode, the module will only execute the commands in the user command list and will not automatically acquire data. Refer to the Auto-Polling section for more information.

Mode	Use Auto-Poll	Use Command List
N (None)	N	Y
M (Multi-drop)	Y	Y
P (Point-to-Point)	Y	Y

When configured for Point-to-Point communication, the channel will automatically poll data from the connected slave address 0.

When configured for Multi-drop, the channel will automatically poll data from the connected slaves in the network (address 1 to 15). Refer to the Auto-Polling section for more information about auto-poll mode.

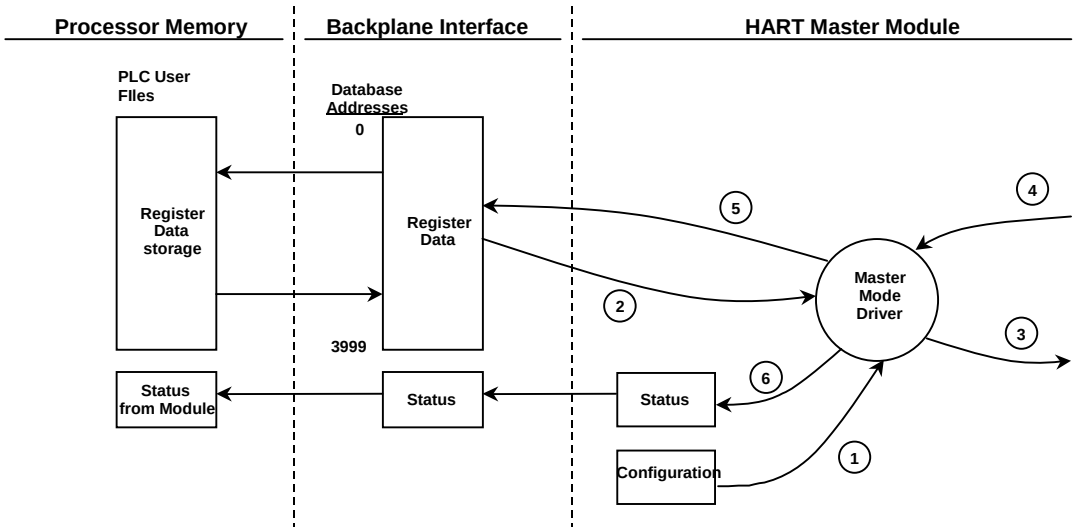
User-configured commands can be issued on each channel to the HART devices. Up to 99 commands can be defined for each port. Data read from the devices is placed in the virtual database of the module, which is passed between the module and the processor.

Any write requests or device-specific commands for the HART slave devices are sourced with data from the virtual database, or from a configured constant data block. Within the commands, it can be specified whether or not to use the HART device's short or long address. If the long address is selected, the device is polled first with short address to ask for the long one. Then, the device is polled with the long address. The module does this processing automatically.

In a HART network, it is possible to have two masters. The module fully supports the existence of a second master, but it can reduce the throughput on the HART network. This facility is enabled or disabled in the module's configuration. If the ability to have a second master on the network is disabled, then the maximum communication throughput is achieved.

5.2.6 Master Driver

The master driver supported on each application port of the module emulates a HART master device. Configuration of each port is independent and should be connected to different HART networks. Up to 15 devices can be connected to each channel. Control of the slave devices by the master port is through the use of a user-constructed command list auto-polling, if enabled. Data for these commands is sourced from the module's database. Data read from the slave devices is placed in the module's database. The following diagram shows the operation of the master driver:



1 The master driver is configured as specified by the HART.CFG file
2 The master will construct control commands using the data in the database
3 The master will send these commands and read requests out on the network
4 Response messages generated by controlled devices on the network are received by the master driver
5 Read data received by the master is passed to the module's database and passed to the processor
6 Additionally, status data for the module is passed to the processor

HART Command List

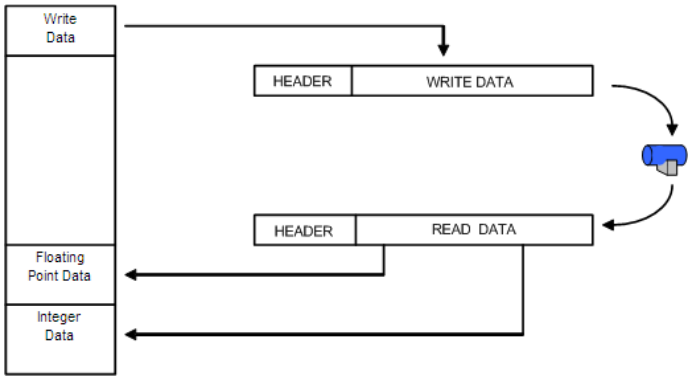
The HART Command List specifies the commands to be executed to the HART devices connected to a channel. A HART command can be seen as an outgoing message to the HART devices that provides Write Data for a specific command or a response message that carries process data (Read Data) back to the module. The MVI71 module supports three kinds of data blocks in the Universal and Common Practice commands. These data blocks are:

- Integers
- IEEE 754 Floating Point Numbers (32 bits)
- Packed ASCII character strings

The Packed ASCII character strings are unpacked and placed with the integers data block.

For all commands, it is possible to select where the Write Data comes from; it can be in the module's internal database or it can be configured as a fixed data block in the command.

For response messages from HART devices, it is possible to configure where the Floating Point Data and Integer Data will be placed in the module's internal database, but this is only possible for the Universal and Common Practice commands. In the case of Device Specific commands, all the Read Data is placed in the Integer data section. See HART Command Support for a listing of supported HART commands.



Burst Mode

If a slave on a network will be placed in burst mode, its data can be placed in the module's database. For the command to be burst by slave device, enter a command in the user command list with the appropriate HART command number. Set the type field to 0 to disable the command. The parameters in the command will be used to store the data received from the bursting slave. There can only be one slave bursting on the network at any one time. This mode can be used for faster update of data from a slave.

5.2.7 Auto-Polling

This feature is enabled by setting the AUTO-POLL CODE (in the configuration file) to a value of P (point-to-point) or M (multi-drop). If the value N is entered for the parameter, the auto-poll feature is disabled. When the feature is disabled, the channel will only execute the commands enabled in the user command list. When the auto-polling mode is enabled, the module will automatically acquire data from the HART instruments attached to a channel without the use of user commands. If user commands are present and enabled when the feature is enabled, they will also be executed independent of auto-polling.

With the auto-poll feature enabled, the module automatically generates the following HART commands and stores the data in the module's database at the user-specified location:

CMD	Description
0	Read Unique Identifier
3	Read Current and Four Dynamic Variables
13	Read Tag, Descriptor and Date
14	Read PV Sensor Information
15	Read Output Information

If the unit is set for point-to-point mode, the module will automatically gather the information for the device with the polling address (short address) of zero and place the data into the database. Each device requires a 50-word database area with the format shown in the following table.

DB Byte Offset	Type	Description	Byte Cnt	Data Source	Use of Data
0	byte	Auto-polling command status bits	1	App	Status
1	byte	Last first status byte received from device	1	Resp	Status
2	byte	Last second status byte received from device	1	Resp	Status
3	byte	Manufacture ID Code	1	CMD 0	LongAddress
4	byte	Device Type Code	1	CMD 0	LongAddress
5	byte	Minimum number of preambles	1	CMD 0	Msgconstruction
6	byte	Universal Command Major Rev #	1	CMD 0	Msgchoice
7	byte	Device Revision Level	1	CMD 0	Info
8	byte	Software Revision Level	1	CMD 0	Info
9	byte	Hardware Revision Level/Physical Signaling Code	1	CMD 0	Info
10	byte	Device Flags	1	CMD 0	Info
11 to 13	byte	Device ID	3	CMD 0	Long Address
14	byte	Minimum number of preambles to be sent with the response message from the slave to the master.	1	CMD 0	
15	byte	Maximum number of device variables	1	CMD 0	Info
16 to 17	word	Configuration Change Counter	2	CMD 0	Info
18	byte	Extended Field Device Status	1	CMD 0	Info
19	byte	Primary variable units code	1	CMD 3	Cfg
20	byte	Secondary variable units code	1	CMD 3	Cfg
21	byte	Tertiary variable units code	1	CMD 3	Cfg
22	byte	Quaternary variable units code	1	CMD 3	Cfg
23 to 30	byte	Tag name	8	CMD 13	Info
31 to 46	byte	Descriptor	16	CMD 13	Info
47 to 49	byte	Tag/Descriptor data	3	CMD 13	Info
50 to 52	byte	Transducer serial number	3	CMD 14	Info

DB Byte Offset	Type	Description	Byte Cnt	Data Source	Use of Data
53	byte	Transducer limits and min span units code	1	CMD 14	Info
54	byte	PV alarm selection code	1	CMD 15	Info
55	byte	PV transfer function code	1	CMD 15	Info
56	byte	PV upper and lower range value units code	1	CMD 15	Info
57	byte	Write protection code	1	CMD 15	Status
58	byte	Private label distributor code	1	CMD 15	Info
59	byte	PV analogchannel flag	1	CMD 15	Info
		TOTAL BYTE COUNT	60		
		TOTAL WORD COUNT	30		

DB Byte Offset	Type	Description	Byte Cnt	Data Source	Use of Data
60 to 63	float	Primary variable value	4	CMD 3	Status
64 to 67	float	Secondary variable value	4	CMD 3	Status
68 to 71	float	Tertiary variable value	4	CMD 3	Status
72 to 75	float	Quaternary variable value	4	CMD 3	Status
76 to 79	float	Upper transducer limit	4	CMD 14	Cfg
80 to 83	float	Lower transducer limit	4	CMD 14	Cfg
84 to 87	float	Minimum span	4	CMD 14	Cfg
88 to 91	float	PV upper range value	4	CMD 15	Cfg
92 to 95	float	PV lower range value	4	CMD 15	Cfg
96 to 99	float	PV damping value (in seconds)	4	CMD 15	Cfg
		TOTAL FLOAT BYTE COUNT	40		
		TOTAL FLOAT WORD COUNT	20		

DB Regs/Device	50
Max DB Regs/channel for 15 Devices	750
Max DB Regs for HART Card	3000

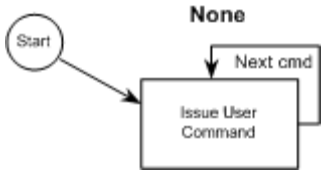
The following table defines the auto-polling command status bits:

Bit #	Description
0	Long Address Set (command 0 successful)
1	Command 13 successful (configuration)
2	Command 14 successful (configuration)
3	Command 15 successful (configuration)
4	Command 3 successful (data polling)
5	Reserved
6	Reserved
7	Reserved

The following topics describe the modes of module operation.

Auto-Poll Disabled Mode

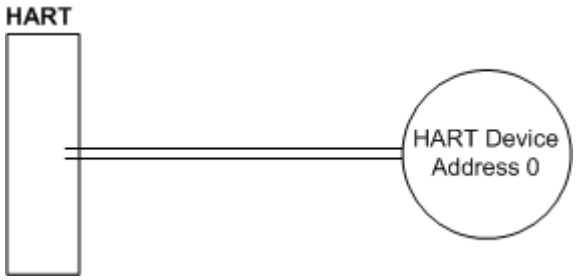
If the auto-polling feature is disabled (Auto-Poll Code = N), the module functions as shown in the following diagram:



Only the user commands are executed and all data is placed in and sourced from the module's internal database. The user is responsible for constructing all commands to control and monitor the instruments attached to the channel.

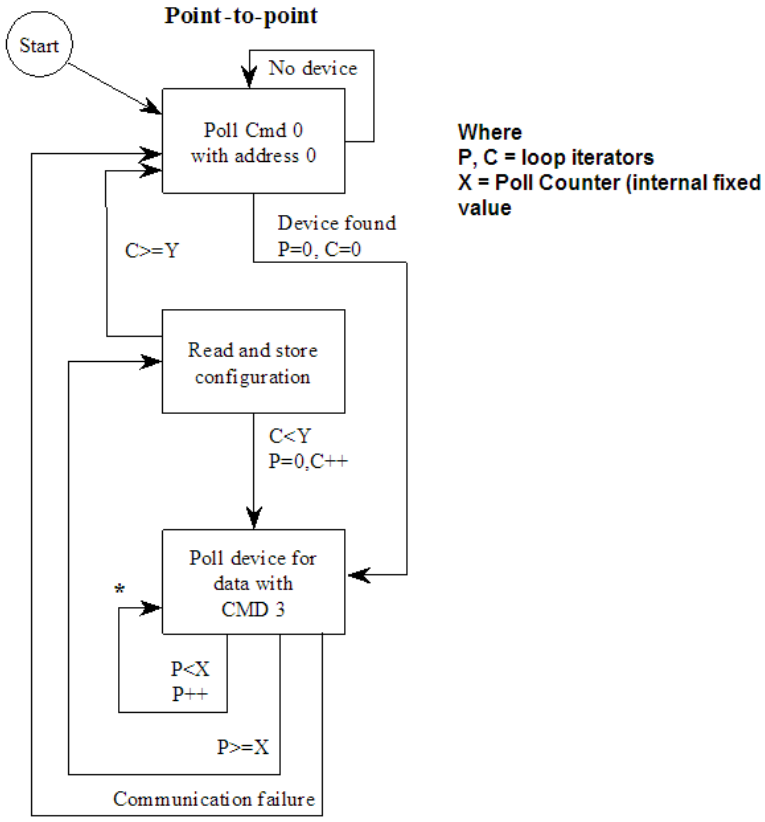
Point-to-Point Mode

Important: If the HART device address is 0 you must configure the channel for Point-to-Point mode.



In point-to-point mode, the module only polls for a single instrument with a polling address of zero. When the instrument is found by the channel, it continuously polls for the data using command 3. Occasionally, it will poll for the configuration information for the device. This is accomplished with HART commands 13, 14 and 15. Less frequently, the channel will perform a HART command 0 request to see if any of the data for the instrument has changed. If communications is lost with the device, the module will try to establish communications with the device using command 0. If user commands are present and enabled, they will be executed after each data poll.

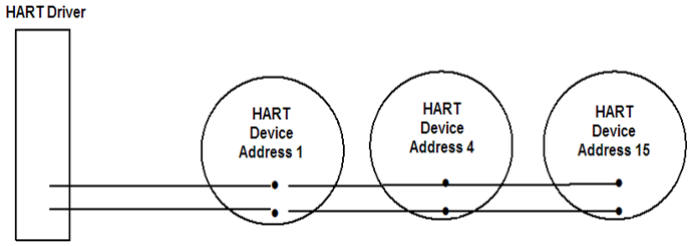
When the point-to-point mode of auto-polling is enabled (Auto-Poll Code = P), the following diagram applies to the channel operation:



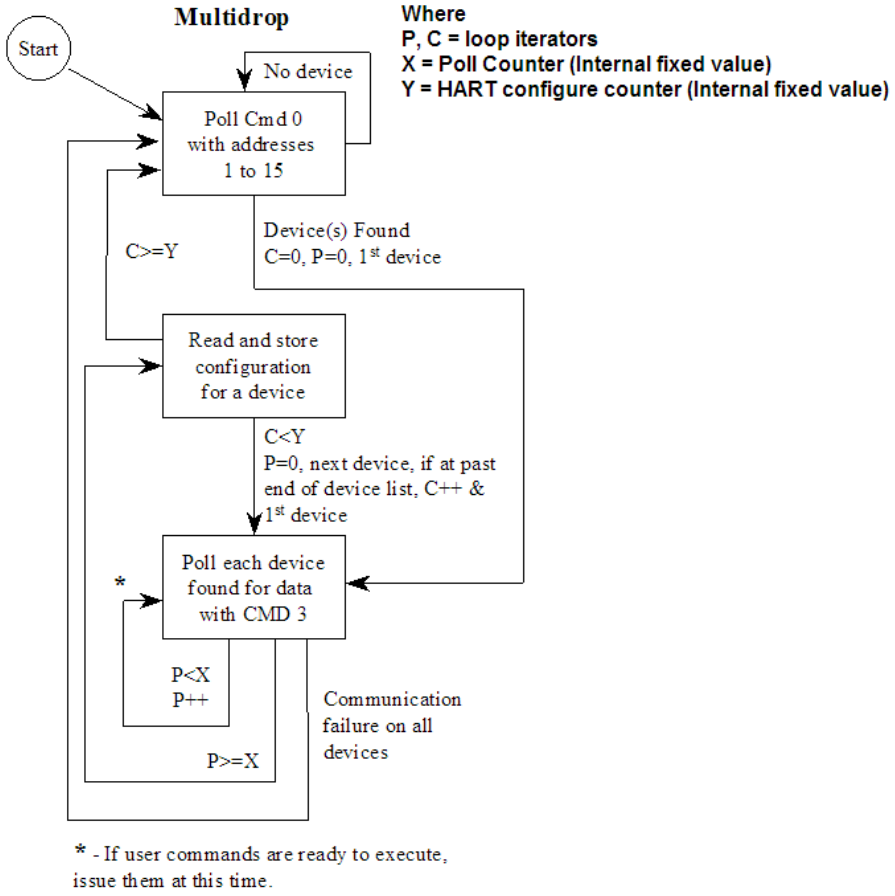
Multi-drop Mode

Important: If the HART device address is between 1 and 15, you must configure the channel for multi-drop mode.

If the unit is set for multi-drop mode, the module will poll each unit attached to the channel starting with polling address 1. The parameter MAX DEVICE COUNT in the configuration determines the maximum slave address number to be polled in multi-drop mode. For example, if the MAX DEVICE COUNT parameter is set to 3, the channel will poll for polling addresses 1, 2, and 3. It is important when assigning the device polling addresses for instruments on a channel to start with 1 and successfully increase the value by one until the last instrument is assigned an address. If you set the MAX DEVICE COUNT parameter to 2, and assign the two instruments addresses 1 and 15, the polling address 15 will never be used (only addresses 1 and 2). Therefore, the second instrument will never be polled and will be in communication failure. Up to 15 instruments can be assigned to a single channel (polling address 1 to 15).



If the module is configured for multi-drop auto-polling (Auto-Poll Code = M), the following diagram applies:


Multidrop
Where
P, C = loop iterators
X = Poll Counter (Internal fixed value)
Y = HART configure counter (Internal fixed value)
Start
No device
Poll Cmd 0 with addresses 1 to 15
Device(s) Found C=0, P=0, 1st device
C>=Y
Read and store configuration for a device
C<Y P=0, next device, if at past end of device list, C++ & 1st device
Poll each device found for data with CMD 3
*
P<X P++
P>=X
Communication failure on all devices
* - If user commands are ready to execute, issue them at this time.

In multi-drop mode, the channel will poll for instruments 1 to the value set in the MAX DEVICE COUNT parameter. For each device found, it will continuously poll for data using command 3. After a certain number of iterations, the HART Driver will ready the configuration data for the next device (if there is one). Each time configuration information is acquired, it will be for a different slave device if more than 1 slave is recognized by the channel. Less frequently, the channel will poll for devices not found in the original search of the network using HART command 0. If communications is lost with all devices, the module will try to establish communications with the devices using command 0. If user commands are present and enabled, they will be executed after the data polling of the devices.

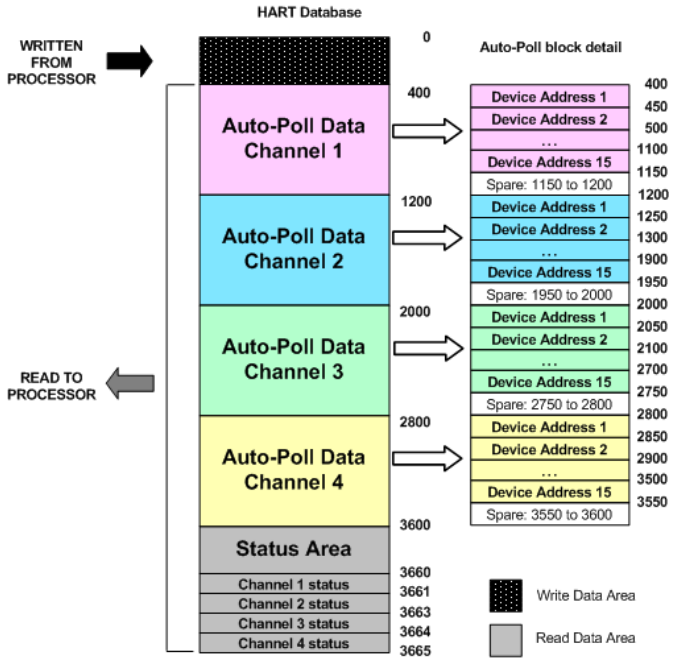
Multi-drop Mode Example:

The intent is to show when using Multi-drop mode how the Auto-Poll DB Address and Max Device Count parameters should be used.

If the configuration file sets the following parameters:

Parameter	Value	Config File Section
DB Address Status	3660	[HART PORT 0]
Auto-Poll DB Address	400	
Max Device Count	15	
DB Address Status	3661	[HART PORT 1]
Auto-Poll DB Address	1200	
Max Device Count	15	
DB Address Status	3662	[HART PORT 2]
Auto-Poll DB Address	2000	
Max Device Count	15	
DB Address Status	3663	[HART PORT 3]
Auto-Poll DB Address	2800	
Max Device Count	15	

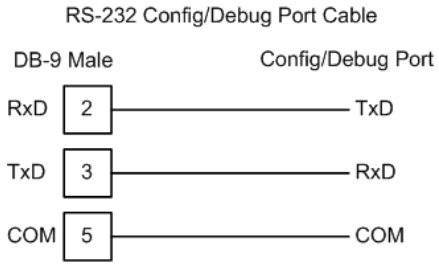
The HART database has the following structure.



The configuration file for this example shows that when the MAX Device Address parameter is configured as 15, the module will reserve 750 words for each channel (15 devices x 50 words each) even though not all devices may be present on the network.

5.3 RS-232 Configuration/Debug Port

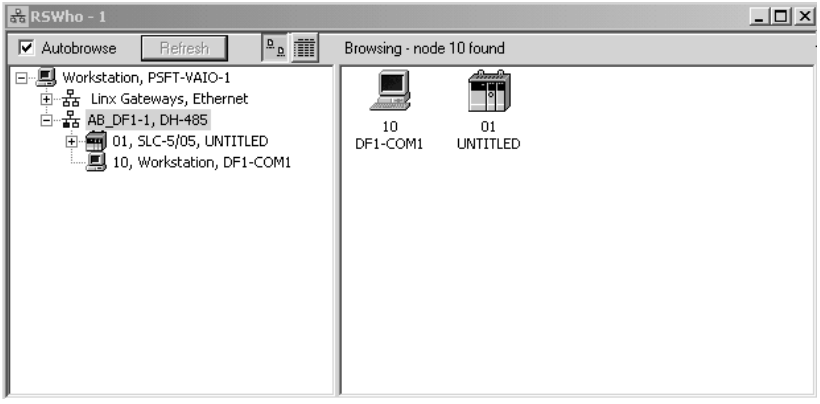
This port is physically an RJ45 connection. An RJ45 to DB-9 adapter cable is included with the module. This port permits a PC based terminal emulation program to view configuration and status data in the module and to control the module. The cable for communications on this port is shown in the following diagram:



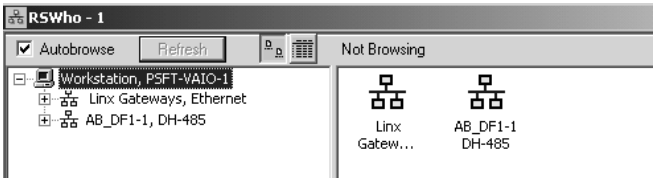
5.3.1 Disabling the RSLinx Driver for the Com Port on the PC

The communication port driver in RSLinx can occasionally prevent other applications from using the PC's COM port. If you are not able to connect to the module's configuration/debug port using ProSoft Configuration Builder (PCB), HyperTerminal or another terminal emulator, follow these steps to disable the RSLinx Driver.

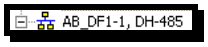
1. Open RSLinx and go to Communications>RSWho
2. Make sure that you are not actively browsing using the driver that you wish to stop. The following shows an actively browsed network:



3 Notice how the DF1 driver is opened, and the driver is looking for a processor on node 1. If the network is being browsed, then you will not be able to stop this driver. To stop the driver your RSWho screen should look like this:

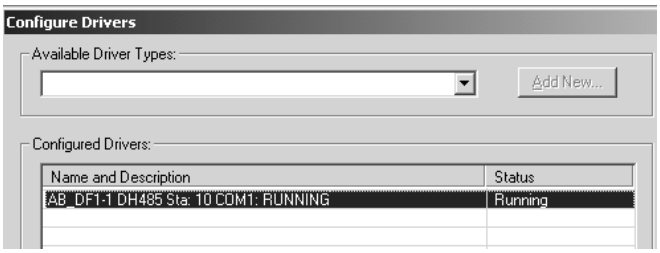


Branches are displayed or hidden by clicking on the ⊞ or the ⊟ icons.



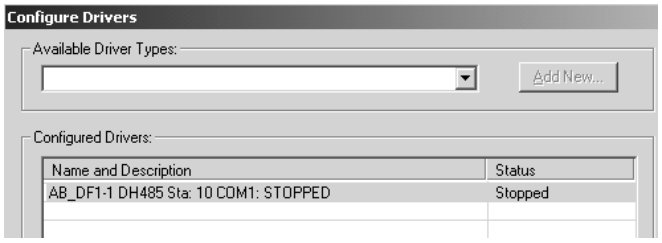
4 When you have verified that the driver is not being browsed, go to

Communications>Configure Drivers
You may see something like this:



If you see the status as running, you will not be able to use this com port for anything other than communication to the processor. To stop the driver press the "Stop" on the side of the window:

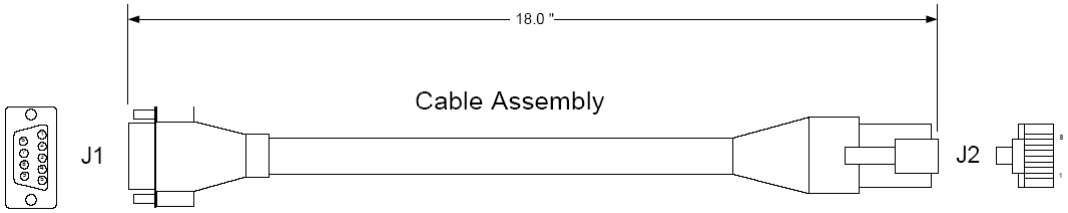
5 After you have stopped the driver you will see the following:

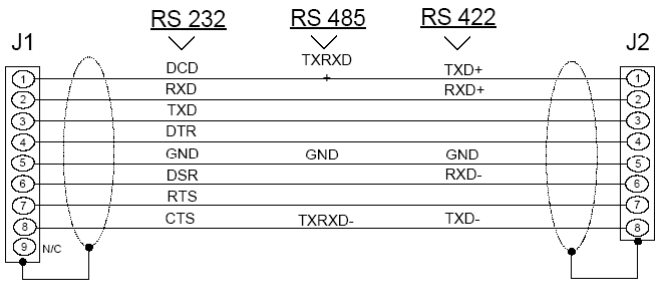


6 Upon seeing this, you may now use that com port to connect to the debug port of the module.

Note: You may need to shut down and restart your PC before it will allow you to stop the driver (usually only on Windows NT machines). If you have followed all of the above steps, and it will not stop the driver, then make sure you do not have RSLogix open. If RSLogix is not open, and you still cannot stop the driver, then reboot your PC.

5.4 DB9 to RJ45 Adaptor (Cable 14)

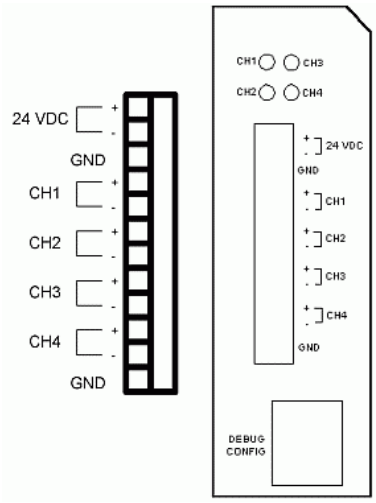




Wiring Diagram

5.5 Application Port Connection

The MVI71-HART module has a single terminal connector to attach the module to the HART networks. Refer to Example Field Terminations (page 84) for diagrams displaying different field termination examples.



5.6 Example Field Terminations

		Up to 15 instruments per channel	One instrument per channel	
		Multi-drop Mode (address 1 to 15)	**Point to Point Mode (address 0 to 15)**	**Point to Point Mode with Analog (address 0 only)**
Power Mode A 24VDC connected to HART power terminals 1 and 2 on terminal block	Master Powered instruments on all 4 channels	OK Install 250Ω 1KΩ	OK Install 1K resistor	OK
Power Mode B HART power terminals 1 and 2 on terminal block left open	Loop Powered instruments on 1 or more channels	OK	OK	OK - differential or single ended analog signal
	Self Powered instruments on 1 or more channels	Not possible	OK	OK -differential or single ended analog signal

5.6.1 Notes

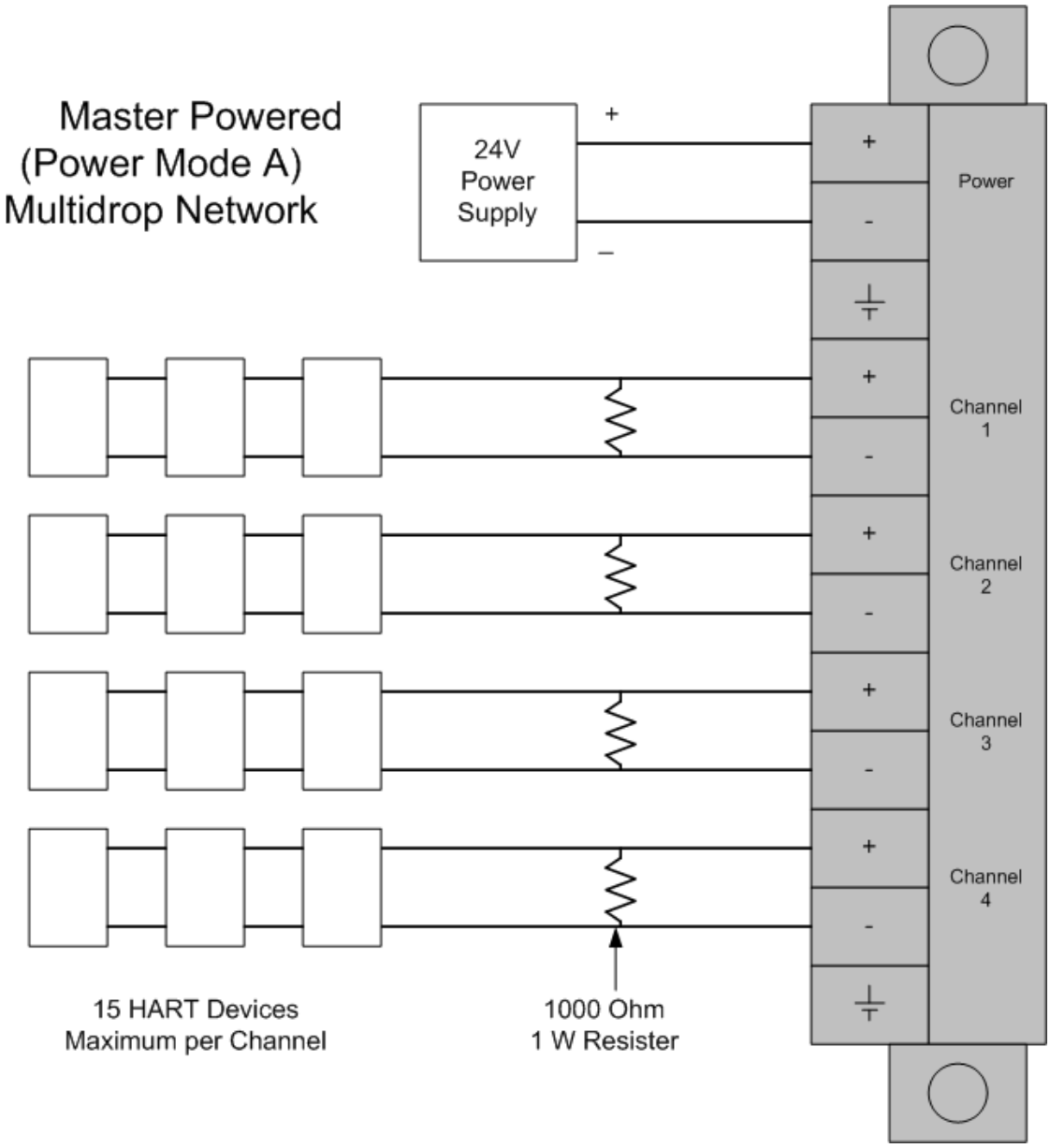
1 All four channels on the unit must be either Master Powered (Power Mode A) or must be Loop or Self powered (Power Mode B). You cannot mix Power Mode A and Power Mode B on the same unit. You can mix Loop powered and Self powered instruments on the same unit. However, you cannot mix Loop powered and Self powered instruments on the same channel.

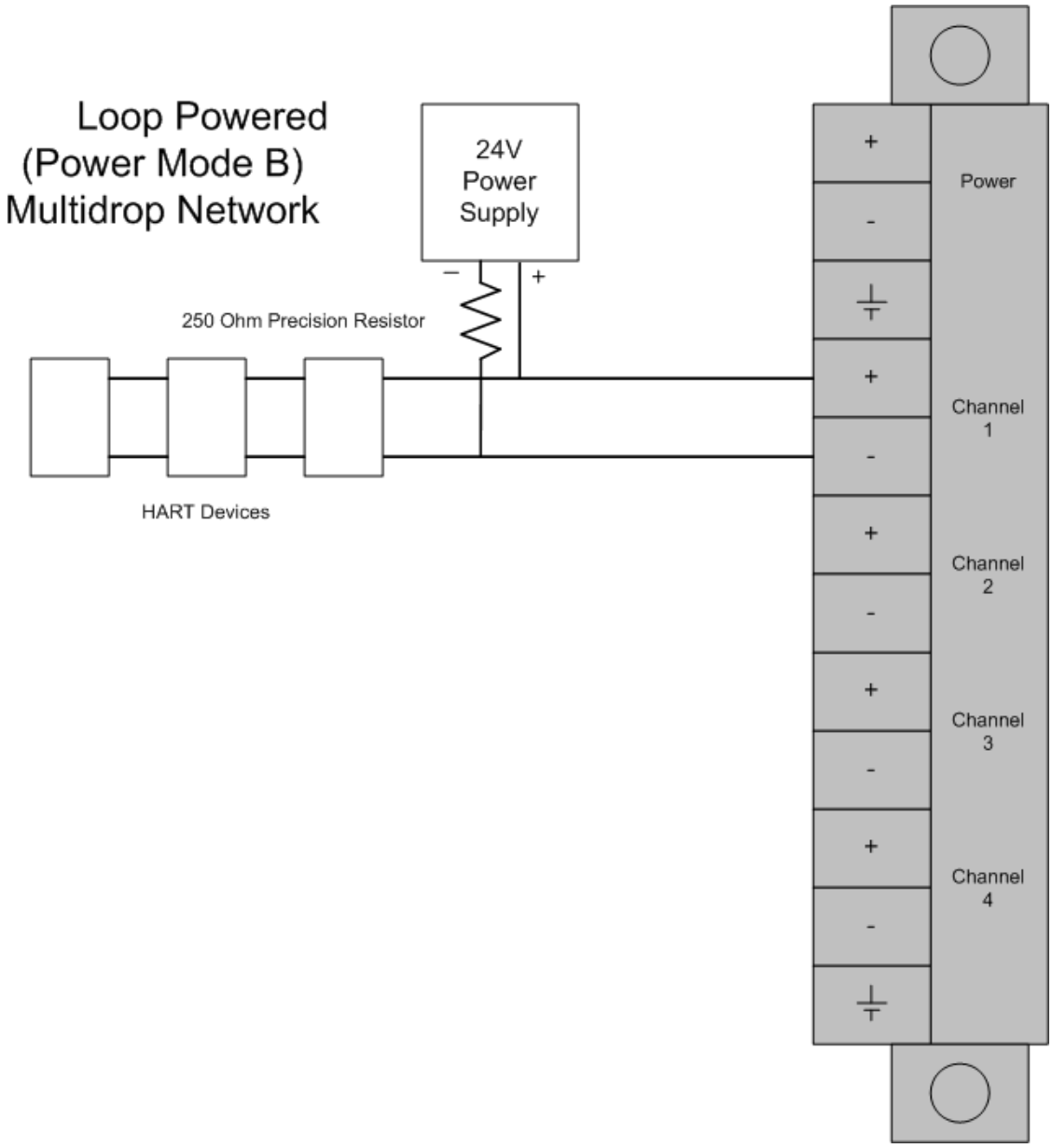
2 For Master Powered, Multi-drop Mode and Point to Point Mode, a 1K, 1W resistor must be connected across the + and - input terminals of each HART channel. Resistors are supplied with each product.

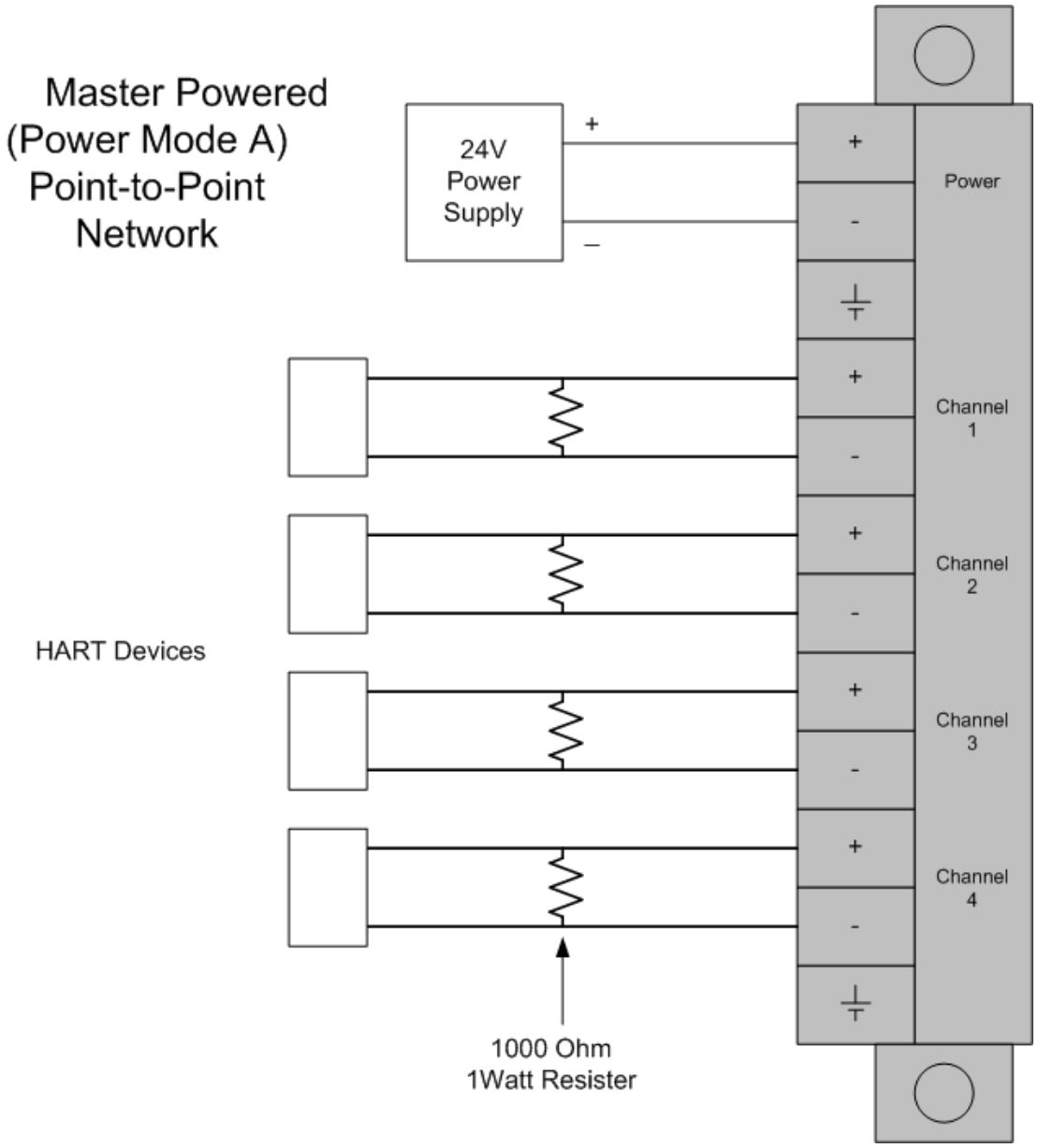
3 When configuring loop powered instruments in a Power Mode B type multi-drop network, use only one power supply per HART channel if you wish to maintain channel to channel isolation. If channel to channel isolation is not required, the same power supply may be used for all four channels. However, a separate series resistor is required for each channel. An appropriately sized resistor must be connected in series with the power supply for each channel. The value and power rating of the resistor is dependant upon the number of instruments in the loop and the length and gauge of the pair of wires connecting the instruments to the unit. 250 Ohm, 3 Watt is a good, first choice value.

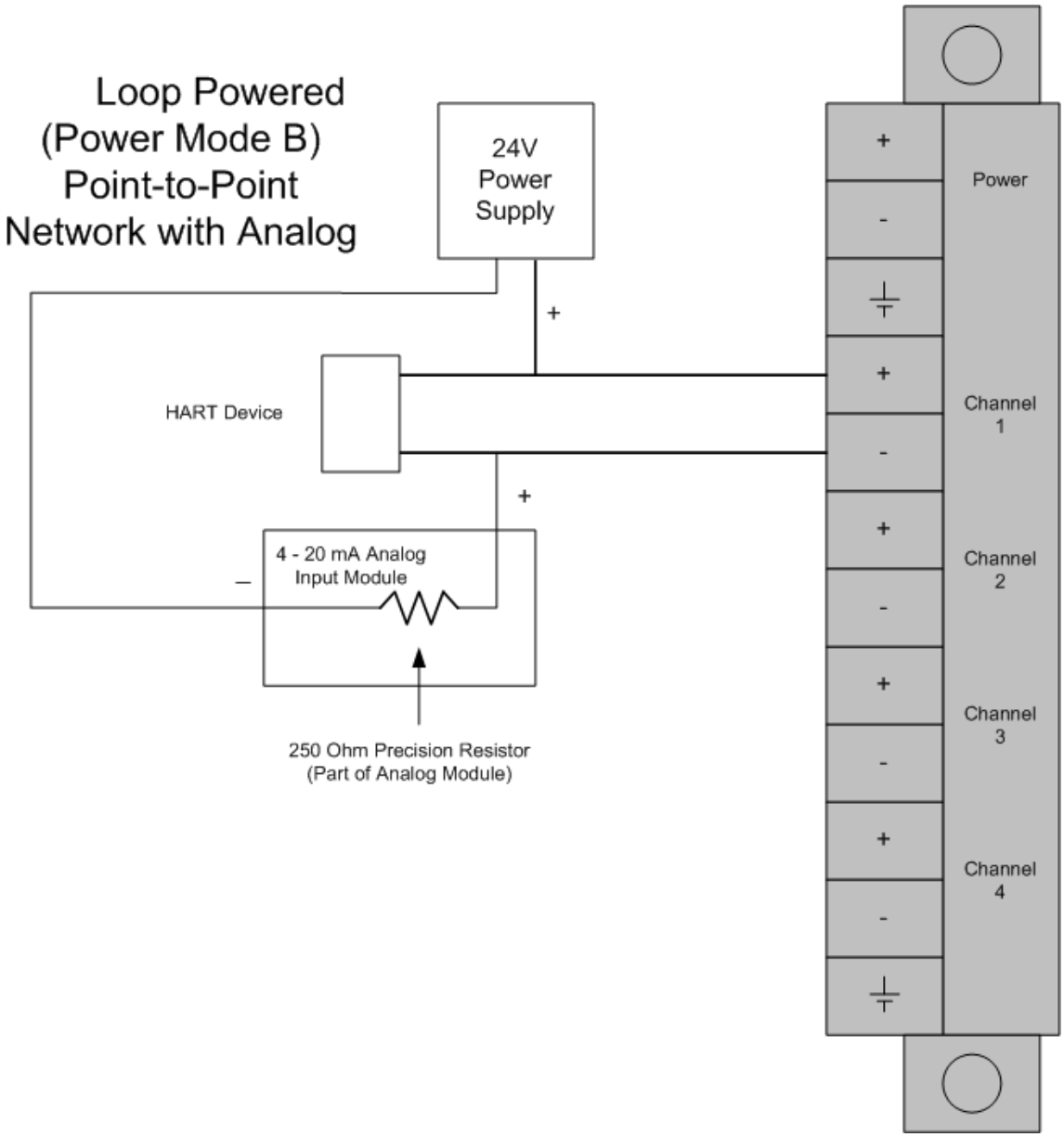
4 If field instrument wiring is shielded, terminate shields at the ground terminals of the HART connector. Do not terminate the shields at the instrument.

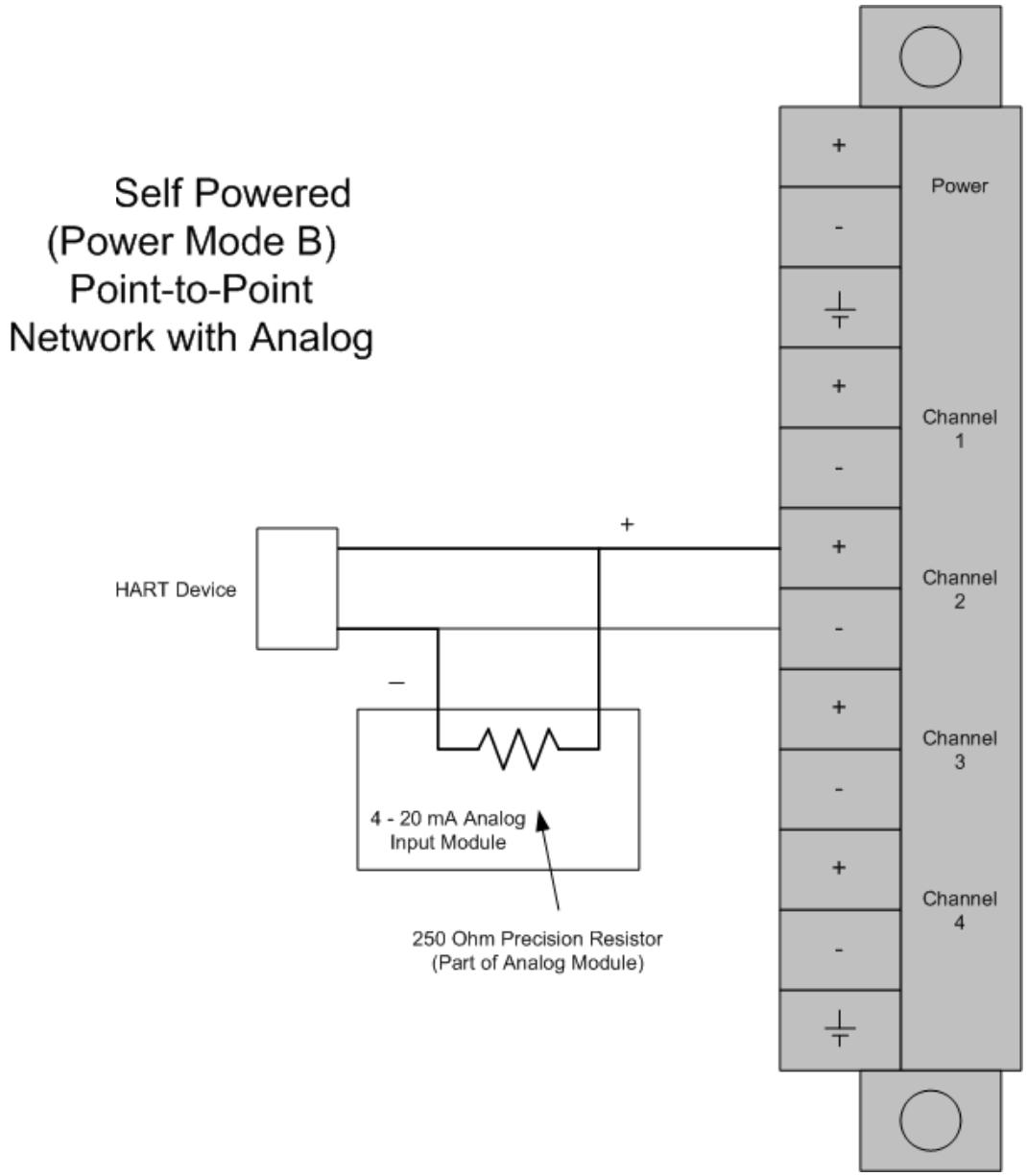
5 For multi-drop applications, the 1KΩ resistor should be normally used when one transmitter is connected to the port. If you increase the number of devices connected to a single port, you may need to reduce the size of the resistor.

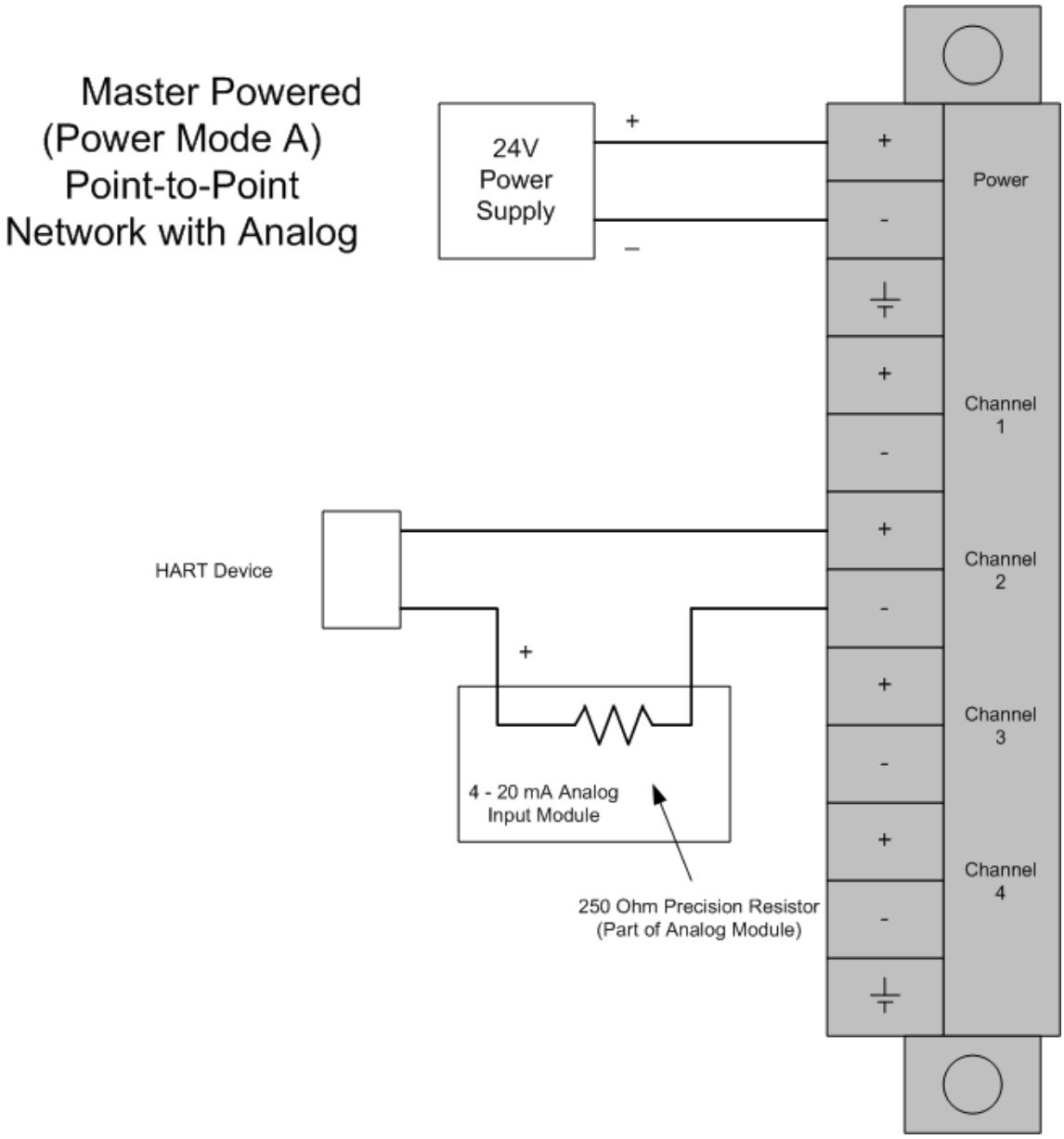

Master Powered
(Power Mode A)
Multidrop Network
24V
Power
Supply
+
–
+
-
Power
+
-
Channel
1
+
-
Channel
2
+
-
Channel
3
+
-
Channel
4
15 HART Devices
Maximum per Channel
1000 Ohm
1 W Resister


Loop Powered
(Power Mode B)
Multidrop Network
24V
Power
Supply
–
+
250 Ohm Precision Resistor
HART Devices
+
-
Power
+
-
Channel
1
+
-
Channel
2
+
-
Channel
3
+
-
Channel
4


Master Powered
(Power Mode A)
Point-to-Point
Network
24V
Power
Supply
+
–
+
-
Power
Channel
1
Channel
2
Channel
3
Channel
4
HART Devices
1000 Ohm
1Watt Resister


Loop Powered
(Power Mode B)
Point-to-Point
Network with Analog
24V
Power
Supply
+
HART Device
+
4 - 20 mA Analog
Input Module
–
250 Ohm Precision Resistor
(Part of Analog Module)
+
-
Power
+
-
Channel
1
+
-
Channel
2
+
-
Channel
3
+
-
Channel
4


Self Powered
(Power Mode B)
Point-to-Point
Network with Analog
+
-
Power
+
-
Channel
1
+
-
Channel
2
+
-
Channel
3
+
-
Channel
4
HART Device
+
–
4 - 20 mA Analog
Input Module
250 Ohm Precision Resistor
(Part of Analog Module)


Master Powered
(Power Mode A)
Point-to-Point
Network with Analog
24V
Power
Supply
+
–
+
-
Power
Channel
1
Channel
2
Channel
3
Channel
4
HART Device
+
4 - 20 mA Analog
Input Module
250 Ohm Precision Resistor
(Part of Analog Module)

5.7 MVI71-HART Status Data Area and Error Codes

This section contains a listing of the data contained in the MVI71-HART status data object, configuration error word and module error codes.

Offset	Content	Description
0	Program Scan Count	This value is incremented each time a complete program cycle occurs in the module.
1 to 2	Product Code	These two registers contain the product code of "HRT7 "
3 to 4	Product Version	These two registers contain the product version for the current running software.
5 to 6	Operating System	These two registers contain the month and year values for the program operating system.
7 to 8	Run Number	These two registers contain the run number value for the currently running software.
9	Read Block Count	This field contains the total number of read blocks transferred from the module to the processor.
10	Write Block Count	This field contains the total number of write blocks transferred from the processor to the module.
11	Parse Block Count	This field contains the total number of blocks successfully parsed that were received from the processor.
12	Reserved	Not used
13	Command Block Count	This field contains the total number of command blocks received from the processor for enable and disable requests.
14	Error Block Count	This field contains the total number of block errors recognized by the module.
15	Port 1 State	Port 1 state machine value (used for debugging)
16	Comm State	Port 1 communication state machine value (used for debugging)
17	Port 1 Device Status (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in error. If the bit is clear (0), the slave is not in error.
18	Port 1 Device Poll List (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in the poll list. If the bit is clear (0), the slave is not in the poll list.
19	Port 1 Device With Long Address (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave uses the long address. If the bit is clear (0), the slave does not use the long address.
20	Port 1 Current Command	This field contains the index of the current command to execute.
21	Port 1 Command Request Count	This field contains the total number of request messages issued on the port.
22	Port 1 Command Response Count	This field contains the total number of response messages received from devices on the network.

Offset	Content	Description
23	Port 1 Configuration Error Word	Configuration error word (see table)
24	Port 1 Current Error Code	Current error code for port
25	Port 1 Last Error Code	Last error code reported for port
26	Port 2 State	Port 2 state machine value (used for debugging)
27	Comm State	Port 2 communication state machine value (used for debugging)
28	Port 2 Device Status (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in error. If the bit is clear (0), the slave is not in error.
29	Port 2 Device Poll List (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in the poll list. If the bit is clear (0), the slave is not in the poll list.
30	Port 2 Device With Long Address (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave uses the long address. If the bit is clear (0), the slave does not use the long address.
31	Port 2 Current Command	This field contains the index of the current command to execute.
32	Port 2 Command Request Count	This field contains the total number of request messages issued on the port.
33	Port 2 Command Response Count	This field contains the total number of response messages received from devices on the network.
34	Port 2 Configuration Error Word	Configuration error word (see table)
35	Port 2 Current Error Code	Current error code for port
36	Port 2 Last Error Code	Last error code reported for port
37	Port 3 State	Port 3 state machine value (used for debugging)
38	Comm State	Port 3 communication state machine value (used for debugging)
39	Port 3 Device Status (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in error. If the bit is clear (0), the slave is not in error.
40	Port 3 Device Poll List (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in the poll list. If the bit is clear (0), the slave is not in the poll list.
41	Port 3 Device With Long Address (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave uses the long address. If the bit is clear (0), the slave does not use the long address.
42	Port 3 Current Command	This field contains the index of the current command to execute.

Offset	Content	Description
43	Port 3 Command Request Count	This field contains the total number of request messages issued on the port.
44	Port 3 Command Response Count	This field contains the total number of response messages received from devices on the network.
45	Port 3 Configuration Error Word	Configuration error word (see table)
46	Port 3 Current Error Code	Current error code for port
47	Port 3 Last Error Code	Last error code reported for port
48	Port 4 State	Port 4 state machine value (used for debugging)
49	Comm State	Port 4 communication state machine value (used for debugging)
50	Port 4 Device Status (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in error. If the bit is clear (0), the slave is not in error.
51	Port 4 Device Poll List (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave is in the poll list. If the bit is clear (0), the slave is not in the poll list.
52	Port 4 Device With Long Address (bit mapped)	Each bit in this word corresponds to a slave address on the network starting at bit 1 for slave address 1. Bit 0 is not used. If the bit is set, the slave uses the long address. If the bit is clear (0), the slave does not use the long address.
53	Port 4 Current Command	This field contains the index of the current command to execute.
54	Port 4 Command Request Count	This field contains the total number of request messages issued on the port.
55	Port 4 Command Response Count	This field contains the total number of response messages received from devices on the network.
56	Port 4 Configuration Error Word	Configuration error word (see table)
57	Port 4 Current Error Code	Current error code for port
58	Port 4 Last Error Code	Last error code reported for port
59 to 61	Reserved	Not used

The following table defines the contents of the configuration error word. Each bit in the word corresponds to an error condition recognized when the module is configured. There is a separate word for each application port. This data is reported in the status data area previously defined.

Bit	Code	Description
0	0x0001	Enabled not set to Y or N
1	0x0002	Enable Handheld not set to Y or N
2	0x0004	Primary Master not set to Y or N
3	0x0008	Invalid Preambles (1 to 50)
4	0x0010	Invalid Short Address Retries (0 to 50)
5	0x0020	Invalid Long Address Retries (0 to 50)

Bit	Code	Description
6	0x0040	Invalid Retries After Error (0 to 50)
7	0x0080	Invalid Poll Time After Error (0 to 10000)
8	0x0100	Invalid DB Address Status
9	0x0200	Invalid Command Count
10	0x0400	Memory Error in allocating commands
11	0x0800	Memory Error in allocating command fixed data
12	0x1000	Memory Error in allocating TX/RX buffers
13	0x2000	HART Board not found
14	0x4000	Cannot initialize HART channel
15	0x8000	

Each command in the command list for each HART channel has a word value for a status/error code. This error data list can be read using the Configuration/Debug Port and can be placed in the module's internal database using the Error/Status Offset parameter for each port. Accessing the Debug capabilities of the module is accomplished by connecting a PC to the Debug port, then running a terminal emulation program. This status/error code is the first word of the Integer Data Block returned from every HART command executed. This word has information about the execution of the command by the HART device.

Refer to the following section for a listing of the Error Codes to interpret the status/error codes present in the integer data area. The following illustration shows the location of each error word in the data block:

Word Offset	Description
0	Command 0 Error Value
…	
…	
99	Command 99 Error Value

The module error codes are listed in this section. Error codes returned from the HART device are placed at the first word of the integer data block in the Virtual Database. The error codes are formatted in the word as follows:

If the most-significant bit of the word contains "1", then the most significant byte has a communication error code. The least-significant byte of the word will contain "0".

If the most-significant bit of the word contains "0", the most significant byte contains a command error code. In this case, the least-significant byte contains device malfunction information.

If this word value is "-1" (or 0xFFFF), it means that the command timed out.

Use the error codes returned for each command in the list to determine the success or failure of the command. If the command fails, use the error code to determine the cause of failure.

5.7.1 Protocol Error Codes

These are error codes that are part of the HART protocol. The standard HART error codes are shown in the following tables:

Error Code Word

First Byte								Second Byte							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0

BIT 7 OF FIRST BYTE = 1 **COMMUNICATION ERROR**	
FIRST BYTE	
BIT 6	Parity Error
BIT 5	Overrun Error
BIT 4	Framing Error
BIT 3	Checksum Error
BIT 2	Reserved
BIT 1	RX Buffer Overflow
BIT 0	Undefined
SECOND BYTE	
BIT 0 to BIT 7	All 0

BIT 7 OF FIRST BYTE = 0 **COMMAND ERROR**	
FIRST BYTE	
Bits 6 to 0 (not bit-mapped):	
0	No Error
1	Undefined
2	Invalid Selection
3	Passed Parameter Too Large
4	Passed Parameter Too Small
5	Too Few Data Bytes Received
6	Transmitter-Specific Command Error
7	In Write-Protect Mode
8 to 15	Command Specific Errors (see Below)
16	Access Restricted
32	Device is Busy
64	Command not Implemented
SECOND BYTE	
BIT 7	Device Malfunction
BIT 6	Configuration Changed
BIT 5	Cold Start

BIT 7 OF FIRST BYTE = 0 **COMMAND ERROR**	
BIT 4	Unused
BIT 3	Output Current Fixed
BIT 2	Analog Output Saturated
BIT 1	Variable (Not Primary) Out of Limits
BIT 0	Primary Variable Out of Limits

Command Specific Errors	
8	Update Failed Update In Progress Set to Nearest Possible Value
9	Applied Process Too High Lower Range Value Too High Not in Fixed Current Mode
10	Applied Process Too Low Lower Range Value Too Low Multi-drop Not Supported
11	In Multi-drop Mode Invalid Transmitter Variable Code Upper Range Value Too High
12	Invalid Unit Code Upper Range Value Too Low
13	Both Range Values Out of Limits
14	Pushed Upper Range Value Over Limit Span Too Small

5.8 HART Universal Commands

COMMAND 00 - Read Unique Identifier

Description

This command gets the long address of the HART device plus other manufacturer information like Manufacturer ID, Device Type Code, Software Revision, Hardware Revision, etc.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Constant "254"	Manufacturer Identification Code
2	Manufacturer Device Type Code	Number of Preambles
3	Universal Command Revision	Transmitter Specific Command Revision
4	Software Revision	Hardware Revision
5	Device Function Flags	Device ID Number 1
6	Device ID Number 2	Device ID Number 3

COMMAND 01 - Read Primary Variable

Description

This command gets the device Primary Variable and the Primary Variable Units

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Primary Variable Value	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	0

COMMAND 02 - Read Current And Percent Of Range

Description

This command gets the current of the loop that is forced by the HART device and the Percent of Range of the Current.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Current (mA)	
1		
2	Percent of Range	
3		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 03 - Read Dynamic Variables

Description

This command gets the current and four (predefined) dynamic Variables.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Current (mA)	
1		
2	Primary Variable	
3		
4	Second Variable	
5		
6	Third Variable	
7		
8	Fourth Variable	
9		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	Second Variable Units Code
2	Third Variable Units Code	Fourth Variable Units Code

COMMAND 06 - Write Polling Address

Description

This command sets the polling address of a HART device. Extreme care should be taken when you use this command because you can loose the communication with the device.

Write Parameters

Word	High Byte	Low Byte
0	Polling Address	Polling Address

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Polling Address	0

COMMAND 12 - Read Message

Description

This command reads an ASCII message contained in the HART Device and written by the Write Message command 17.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Message ASCII Character 0	Message ASCII Character 1
2	Message ASCII Character 2	Message ASCII Character 3
.	.	
.	.	
.	.	
14	Message ASCII Character 28	Message ASCII Character 29
15	Message ASCII Character 30	Message ASCII Character 31

COMMAND 13 - Read Tag, Descriptor and Date

Description

This command reads an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 14 - Read PV Sensor Info

Description

This command gets information about the Primary Variable sensor, like limits and span.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Upper Sensor Limit	
1		
2	Lower Sensor Limit	
3		
4	Minimum Span	
5		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Sensor Serial Number 0	Sensor Serial Number 1
2	Sensor Serial Number 2	Unit Codes for Sensor Limits and Span

COMMAND 15 - Read Output Information

Description

This command gets information about the Primary Variable Output Information.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Upper Range Value	
1		
2	Lower Range Value	
3		
4	Damping Value (Sec)	
5		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Alarm Select Code	Transfer Function Code
2	Primary Variable Range Units Code	Write-Protect Code
2	Private-Label Distributor Code	0

COMMAND 16 - Read Final Assembly Number

Description

This command reads the final assembly number of the HART device.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Final Assembly Number 0	Final Assembly Number 1
2	Final Assembly Number 2	0

COMMAND 17 - Write Message

Description

This command writes an ASCII message contained in the HART Device and that can be read with command 12.

Write Parameters

Word	High Byte	Low Byte
0	Packed ASCII Message Byte 0	Packed ASCII Message Byte 1
1	Packed ASCII Message Byte 2	Packed ASCII Message Byte 3
.	.	
.	.	
.	.	
11	Packed ASCII Message Byte 22	Packed ASCII Message Byte 23

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 18 - Write Tag, Descriptor and Date

Description

This command writes an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters

Word	High Byte	Low Byte
0	Packed ASCII TAG Byte 0	Packed ASCII TAG Byte 1
1	Packed ASCII TAG Byte 2	Packed ASCII TAG Byte 3
2	Packed ASCII TAG Byte 4	Packed ASCII TAG Byte 5
3	Packed ASCII Descriptor Byte 0	Packed ASCII Descriptor Byte 1
.	.	
.	.	
.	.	
8	Packed ASCII Descriptor Byte 10	Packed ASCII Descriptor Byte 11
9	Date	Date
10	Date	0

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 19 - Write Final Assembly Number

Description

This command writes the final assembly number of the HART device.

Write Parameters

Word	High Byte	Low Byte
0	Final Assembly Number 0	Final Assembly Number 1
1	Final Assembly Number 2	Final Assembly Number 2

Floating Point Data Returned:

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Final Assembly Number 0	Final Assembly Number 1
2	Final Assembly Number 2	0

5.9 HART Common Practice Commands

COMMAND 33 - Read Transmitter Variables

Description

This command gets four user selected dynamic Variables.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code For Slot 0	Transmitter Variable Code For Slot 1
1	Transmitter Variable Code For Slot 2	Transmitter Variable Code For Slot 3

Floating Point Data Returned

Word	High Byte	Low Byte
0	Variable for Slot 0	
1		
2	Variable for Slot 0	
3		
4	Variable for Slot 2	
5		
6	Variable for Slot 3	
7		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code For Slot 0	Units Code for Slot 0 Variable
2	Transmitter Variable Code For Slot 1	Units Code for Slot 1 Variable
3	Transmitter Variable Code For Slot 2	Units Code for Slot 2 Variable
4	Transmitter Variable Code For Slot 3	Units Code for Slot 3 Variable

COMMAND 34 - Write Damping Value

Description

This command writes the damping value of a HART device.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point Damping Value (Sec)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Damping Value (Sec)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 35 - Write Range Values

Description

This command writes the Upper and Lower range of the Primary Variable

Write Parameters

Word	High Byte	Low Byte
0	Range Units Code	Floating Point Upper Range Value (Byte 0)
1	Floating Point Upper Range Value (Byte 1)	Floating Point Upper Range Value (Byte 2)
2	Floating Point Upper Range Value (Byte 3)	Floating Point Lower Range Value (Byte 0)
3	Floating Point Lower Range Value (Byte 1)	Floating Point Lower Range Value (Byte 2)
4	Floating Point Lower Range Value (Byte 3)	Floating Point Lower Range Value (Byte 3)

Floating Point Data Returned

Word	High Byte	Low Byte
0	Upper Range Value	
1		
2	Lower Range Value	
3		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Range Units Code	0

COMMAND 36 - Set Upper Range Value

Description

This command is similar in effect to push the SPAN button of the HART device but doing it remotely through the HART network.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 37 - Set Lower Range Value

Description

This command is similar in effect to push the ZERO button of the HART device but doing it remotely through the HART network.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 38 - Reset Configuration Changed Flag

Description

This command resets the status bit that indicates that configuration has been changed.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 39 - EEPROM Control

Description

This command operates over the EEPROM changing its settings.

Write Parameters

Word	High Byte	Low Byte
0	EEPROM Control Code	EEPROM Control Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	EEPROM Control Code	0

COMMAND 40 - Enter Exit Fixed Current Mode

Description

This command writes the damping value of a HART device.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 41 - Perform Transmitter Self Test

Description

This command starts the HART device Self Test to find if there is any problem with the device hardware.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 42 - Perform Master Reset

Description

This command performs a master reset in the HART device.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 43 - Set PV Zero

Description

This command forces the Primary Value to Zero.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 44 - Write PV Units

Description

This command changes the setting of the Primary Variable units.

Write Parameters

Word	High Byte	Low Byte
0	Primary Variable Units Code	Primary Variable Units Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	0

COMMAND 45 - Trim DAC Zero

Description

This command calibrates the device Digital to analog converter zero. This is done by writing the same current value that is measured in the loop.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point measured current (mA)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 46 - Trim DAC Gain

Description

This command calibrates the device Digital to analog converter gain. This is done by writing the same current value that is measured in the loop.

Write Parameters

Word	High Byte	Low Byte
0	Floating Point Measured Current (mA)	
1		

Floating Point Data Returned

Word	High Byte	Low Byte
0	Floating Point Current (mA)	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	

COMMAND 47 - Write Transfer Function

Description

This command changes the setting of the Transfer Function of the HART device.

Write Parameters

Word	High Byte	Low Byte
0	Transfer Function Code	Transfer Function Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transfer Function Code	0

COMMAND 48 - Read Additional Transmitter Status

Description

This command gets extended information about the status of the Transmitter. This information is specific for each transmitter.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Additional Status (Byte 0)	Additional Status (Byte 1)
2	Additional Status (Byte 2)	Additional Status (Byte 3)
.	.	
.	.	
.	.	
13	Additional Status (Byte 24)	0

COMMAND 49 - Write PV Sensor Serial Number

Description

This command changes the sensor serial number of the Primary Variable.

Write Parameters

Word	High Byte	Low Byte
0	Sensor Serial Number (Byte 0)	Sensor Serial Number (Byte 1)
1	Sensor Serial Number (Byte 2)	Sensor Serial Number (Byte 2)

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Sensor Serial Number (Byte 0)	Sensor Serial Number (Byte 1)
2	Sensor Serial Number (Byte 2)	0

COMMAND 50 - Read Dynamic Variable Assignments

Description

This command gets the actual assignment of the Dynamic Variables returned with command 3.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code For Primary Variable	Transmitter Variable Code For Second Variable
2	Transmitter Variable Code For Third Variable	Transmitter Variable Code For Fourth Variable

COMMAND 51 - Write Dynamic Variable Assignments

Description

This command sets the assignment of the Dynamic Variables returned with command 3.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code For Primary Variable	Transmitter Variable Code For Second Variable
1	Transmitter Variable Code For Third Variable	Transmitter Variable Code For Fourth Variable

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code For Primary Variable	Transmitter Variable Code For Second Variable
2	Transmitter Variable Code For Third Variable	Transmitter Variable Code For Fourth Variable

COMMAND 52 - Set Transmitter Variable Zero

Description

This command forces a selected transmitter variable to zero.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	0

COMMAND 53 - Write Transmitter Variable Units

Description

This command changes a selected transmitter variable unit.

Write Parameters:

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Units Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	Transmitter Variable Units Code

COMMAND 54 - Read Transmitter Variable Information

Description

This command gets information about any selected transmitter variable sensor.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Code

Floating Point Data Returned

Word	High Byte	Low Byte
0	Transmitter Variable Upper Limit	
1		
2	Transmitter Variable Lower Limit	
3		
4	Transmitter Variable Damping Value (Sec)	
5		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code	Sensor Serial Number 0
1	Sensor Serial Number 1	Sensor Serial Number 2
2	Unit Code for Limits	0

COMMAND 55 - Write Transmitter Variable Damping Value

Description

This command writes the Damping Value of a user selected transmitter variable.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Damping Value (Byte 0)
1	Transmitter Variable Damping Value (Byte 1)	Transmitter Variable Damping Value (Byte 2)
2	Transmitter Variable Damping Value (Byte 3)	Transmitter Variable Damping Value (Byte 3)

Floating Point Data Returned

Word	High Byte	Low Byte
0	Transmitter Variable Damping Value	
1		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code	0

COMMAND 56 - Write Transmitter Variable Sensor Serial Number

Description

This command writes the Serial Number of a user selected transmitter variable.

Write Parameters

Word	High Byte	Low Byte
0	Transmitter Variable Code	Transmitter Variable Sensor Serial Number (Byte 0)
1	Transmitter Variable Sensor Serial Number (Byte 1)	Transmitter Variable Sensor Serial Number (Byte 2)

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Transmitter Variable Code	Transmitter Variable Sensor Serial Number (Byte 0)
2	Transmitter Variable Sensor Serial Number (Byte 1)	Transmitter Variable Sensor Serial Number (Byte 2)

COMMAND 57 - Read Unit Tag Descriptor Date

Description

This command reads an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters

NONE

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 58 - Write Unit Tag Descriptor Date

Description

This command writes an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.

Write Parameters:

Word	High Byte	Low Byte
0	Packed ASCII TAG Byte 0	Packed ASCII TAG Byte 1
1	Packed ASCII TAG Byte 2	Packed ASCII TAG Byte 3
2	Packed ASCII TAG Byte 4	Packed ASCII TAG Byte 5
3	Packed ASCII Descriptor Byte 0	Packed ASCII Descriptor Byte 1
.	.	
.	.	
.	.	
8	Packed ASCII Descriptor Byte 10	Packed ASCII Descriptor Byte 11
9	Date	Date
10	Date	0

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	TAG ASCII Character 0	TAG ASCII Character 1
2	TAG ASCII Character 2	TAG ASCII Character 3
3	TAG ASCII Character 4	TAG ASCII Character 5
4	TAG ASCII Character 6	TAG ASCII Character 7
5	Descriptor ASCII Character 0	Message ASCII Character 1
.	.	
.	.	
.	.	
12	Descriptor ASCII Character 14	Message ASCII Character 15
13	Date	Date
14	Date	0

COMMAND 59 - Write Number Of Response Preambles

Description

This command sets the number of preambles that the HART slave will use in every command response.

Write Parameters

Word	High Byte	Low Byte
0	Number of Response Preambles	Number of Response Preambles

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Number of Response Preambles	0

COMMAND 108 - Write Burst Mode Command Number

Description

This command sets the command number that the HART device will use in Burst Mode.

Write Parameters

Word	High Byte	Low Byte
0	Burst Mode Command Number	Burst Mode Command Number

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Burst Mode Command Number	0

COMMAND 109 - Burst Mode Control

Description

This command sets the HART device Burst Mode.

Write Parameters

Word	High Byte	Low Byte
0	Burst Mode Control Code	Burst Mode Control Code

Floating Point Data Returned

NONE

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Burst Mode Control Code	0

1 = ON

0 = Off

COMMAND 110 - Read All Dynamic Variables

Description

This command gets all dynamic Variables.

Write Parameters

NONE

Floating Point Data Returned

Word	High Byte	Low Byte
0	Primary Variable	
1		
2	Second Variable	
3		
4	Third Variable	
5		
6	Fourth Variable	
7		

Integer Data Returned

Word	High Byte	Low Byte
0	STATUS WORD	
1	Primary Variable Units Code	Second Variable Units Code
2	Third Variable Units Code	Fourth Variable Units Code

6 Support, Service & Warranty

In This Chapter

- How to Contact Us: Technical Support 141
- Return Material Authorization (RMA) Policies and Conditions 142
- LIMITED WARRANTY 143

ProSoft Technology, Inc. (ProSoft) is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

1 Product Version Number
2 System architecture
3 Network details

If the issue is hardware related, we will also need information regarding:

1 Module configuration and contents of file
   - Module Operation
   - Configuration/Debug status information
   - LED patterns

2 Information about the processor and user data files as viewed through and LED patterns on the processor.
3 Details about the serial devices interfaced, if any.

6.1 How to Contact Us: Technical Support

Internet	Web Site: www.prosoft-technology.com/support
	E-mail address: support@prosoft-technology.com

Asia Pacific

+603.7724.2080, support.asia@prosoft-technology.com
Languages spoken include: Chinese, English

Europe (location in Toulouse, France)

+33 (0) 5.34.36.87.20, support.EMEA@prosoft-technology.com
Languages spoken include: French, English

North America/Latin America (excluding Brasil) (location in California)

+1.661.716.5100, support@prosoft-technology.com
Languages spoken include: English, Spanish
*For technical support calls within the United States, an after-*hours *answering system allows pager access to one of our qualified technical and/or application support engineers at any time to answer your questions.*

Brasil (location in Sao Paulo)

+55-11-5084-5178, eduardo@prosoft-technology.com
Languages spoken include: Portuguese, English

6.2 Return Material Authorization (RMA) Policies and Conditions

The following RMA Policies and Conditions (collectively, "RMA Policies") apply to any returned Product. These RMA Policies are subject to change by ProSoft without notice. For warranty information, see "Limited Warranty". In the event of any inconsistency between the RMA Policies and the Warranty, the Warranty shall govern.

6.2.1 All Product Returns:

a) In order to return a Product for repair, exchange or otherwise, the Customer must obtain a Returned Material Authorization (RMA) number from ProSoft and comply with ProSoft shipping instructions.
b) In the event that the Customer experiences a problem with the Product for any reason, Customer should contact ProSoft Technical Support at one of the telephone numbers listed above (page 141). A Technical Support Engineer will request that you perform several tests in an attempt to isolate the problem. If after completing these tests, the Product is found to be the source of the problem, we will issue an RMA.
c) All returned Products must be shipped freight prepaid, in the original shipping container or equivalent, to the location specified by ProSoft, and be accompanied by proof of purchase and receipt date. The RMA number is to be prominently marked on the outside of the shipping box. Customer agrees to insure the Product or assume the risk of loss or damage in transit. Products shipped to ProSoft using a shipment method other than that specified by ProSoft or shipped without an RMA number will be returned to the Customer, freight collect. Contact ProSoft Technical Support for further information.
d) A 10% restocking fee applies to all warranty credit returns whereby a Customer has an application change, ordered too many, does not need, etc.

6.2.2 Procedures for Return of Units Under Warranty:

A Technical Support Engineer must approve the return of Product under ProSoft's Warranty:

a) A replacement module will be shipped and invoiced. A purchase order will be required.
b) Credit for a product under warranty will be issued upon receipt of authorized product by ProSoft at designated location referenced on the Return Material Authorization.

6.2.3 Procedures for Return of Units Out of Warranty:

a) Customer sends unit in for evaluation
b) If no defect is found, Customer will be charged the equivalent of $100 USD, plus freight charges, duties and taxes as applicable. A new purchase order will be required.

c) If unit is repaired, charge to Customer will be 30% of current list price (USD) plus freight charges, duties and taxes as applicable. A new purchase order will be required or authorization to use the purchase order submitted for evaluation fee.

The following is a list of non-repairable units:

- 3150 - All
- 3750
- 3600 - All
- 3700
- 3170 - All
- 3250
- 1560 - Can be repaired, only if defect is the power supply
- 1550 - Can be repaired, only if defect is the power supply
- 3350
- 3300
- 1500 - All

6.2.4 Purchasing Warranty Extension:

a) ProSoft's standard warranty period is three (3) years from the date of shipment as detailed in "Limited Warranty (page 143)". The Warranty Period may be extended at the time of equipment purchase for an additional charge, as follows:

- Additional 1 year = 10% of list price
- Additional 2 years = 20% of list price
- Additional 3 years = 30% of list price

6.3 LIMITED WARRANTY

This Limited Warranty ("Warranty") governs all sales of hardware, software and other products (collectively, "Product") manufactured and/or offered for sale by ProSoft, and all related services provided by ProSoft, including maintenance, repair, warranty exchange, and service programs (collectively, "Services"). By purchasing or using the Product or Services, the individual or entity purchasing or using the Product or Services ("Customer") agrees to all of the terms and provisions (collectively, the "Terms") of this Limited Warranty. All sales of software or other intellectual property are, in addition, subject to any license agreement accompanying such software or other intellectual property.

6.3.1 What Is Covered By This Warranty

a) *Warranty On New Products*: ProSoft warrants, to the original purchaser, that the Product that is the subject of the sale will (1) conform to and perform in accordance with published specifications prepared, approved and issued by ProSoft, and (2) will be free from defects in material or workmanship; provided these warranties only cover Product that is sold as new. This Warranty expires three years from the date of shipment (the "Warranty Period"). If the Customer discovers within the Warranty Period a failure of the Product to conform to specifications, or a defect in material or workmanship of the Product, the Customer must promptly notify ProSoft by fax, email or telephone. In no event may that notification be received by ProSoft later than 39 months. Within a reasonable time after notification, ProSoft will correct any failure of the Product to conform to specifications or any defect in material or workmanship of the Product, with either new or used replacement parts. Such repair, including both parts and labor, will be performed at ProSoft's expense. All warranty service will be performed at service centers designated by ProSoft.
b) *Warranty On Services*: Materials and labor performed by ProSoft to repair a verified malfunction or defect are warranteed in the terms specified above for new Product, provided said warranty will be for the period remaining on the original new equipment warranty or, if the original warranty is no longer in effect, for a period of 90 days from the date of repair.

6.3.2 What Is Not Covered By This Warranty

a) ProSoft makes no representation or warranty, expressed or implied, that the operation of software purchased from ProSoft will be uninterrupted or error free or that the functions contained in the software will meet or satisfy the purchaser's intended use or requirements; the Customer assumes complete responsibility for decisions made or actions taken based on information obtained using ProSoft software.
b) This Warranty does not cover the failure of the Product to perform specified functions, or any other non-conformance, defects, losses or damages caused by or attributable to any of the following: (i) shipping; (ii) improper installation or other failure of Customer to adhere to ProSoft's specifications or instructions; (iii) unauthorized repair or maintenance; (iv) attachments, equipment, options, parts, software, or user-created programming (including, but not limited to, programs developed with any IEC 61131-3, "C" or any variant of "C" programming languages) not furnished by ProSoft; (v) use of the Product for purposes other than those for which it was designed; (vi) any other abuse, misapplication, neglect or misuse by the Customer; (vii) accident, improper testing or causes external to the Product such as, but not limited to, exposure to extremes of temperature or humidity, power failure or power surges; or (viii) disasters such as fire, flood, earthquake, wind and lightning.

c) The information in this Agreement is subject to change without notice. ProSoft shall not be liable for technical or editorial errors or omissions made herein; nor for incidental or consequential damages resulting from the furnishing, performance or use of this material. The user guide included with your original product purchase from ProSoft contains information protected by copyright. No part of the guide may be duplicated or reproduced in any form without prior written consent from ProSoft.

6.3.3 Disclaimer Regarding High Risk Activities

Product manufactured or supplied by ProSoft is not fault tolerant and is not designed, manufactured or intended for use in hazardous environments requiring fail-safe performance including and without limitation: the operation of nuclear facilities, aircraft navigation of communication systems, air traffic control, direct life support machines or weapons systems in which the failure of the product could lead directly or indirectly to death, personal injury or severe physical or environmental damage (collectively, "high risk activities"). ProSoft specifically disclaims any express or implied warranty of fitness for high risk activities.

6.3.4 Intellectual Property Indemnity

Buyer shall indemnify and hold harmless ProSoft and its employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not ProSoft is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Products. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless ProSoft and defend or settle any action brought against such Companies to the extent based on a claim that any Product made to Buyer specifications infringed intellectual property rights of another party. ProSoft makes no warranty that the product is or will be delivered free of any person's claiming of patent, trademark, or similar infringement. The Buyer assumes all risks (including the risk of suit) that the product or any use of the product will infringe existing or subsequently issued patents, trademarks, or copyrights.

a) Any documentation included with Product purchased from ProSoft is protected by copyright and may not be duplicated or reproduced in any form without prior written consent from ProSoft.
b) ProSoft's technical specifications and documentation that are included with the Product are subject to editing and modification without notice.
c) Transfer of title shall not operate to convey to Customer any right to make, or have made, any Product supplied by ProSoft.
d) Customer is granted no right or license to use any software or other intellectual property in any manner or for any purpose not expressly permitted by any license agreement accompanying such software or other intellectual property.

e) Customer agrees that it shall not, and shall not authorize others to, copy software provided by ProSoft (except as expressly permitted in any license agreement accompanying such software); transfer software to a third party separately from the Product; modify, alter, translate, decode, decompile, disassemble, reverse-engineer or otherwise attempt to derive the source code of the software or create derivative works based on the software; export the software or underlying technology in contravention of applicable US and international export laws and regulations; or use the software other than as authorized in connection with use of Product.

f) **Additional Restrictions Relating To Software And Other Intellectual Property**

   In addition to compliance with the Terms of this Warranty, Customers purchasing software or other intellectual property shall comply with any license agreement accompanying such software or other intellectual property. Failure to do so may void this Warranty with respect to such software and/or other intellectual property.

6.3.5 Disclaimer of all Other Warranties

The Warranty set forth in What Is Covered By This Warranty (page 144) are in lieu of all other warranties, express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

*6.3.6 Limitation of Remedies ***

In no event will ProSoft or its Dealer be liable for any special, incidental or consequential damages based on breach of warranty, breach of contract, negligence, strict tort or any other legal theory. Damages that ProSoft or its Dealer will not be responsible for included, but are not limited to: Loss of profits; loss of savings or revenue; loss of use of the product or any associated equipment; loss of data; cost of capital; cost of any substitute equipment, facilities, or services; downtime; the claims of third parties including, customers of the Purchaser; and, injury to property.

** Some areas do not allow time limitations on an implied warranty, or allow the exclusion or limitation of incidental or consequential damages. In such areas, the above limitations may not apply. This Warranty gives you specific legal rights, and you may also have other rights which vary from place to place.

6.3.7 Time Limit for Bringing Suit

Any action for breach of warranty must be commenced within 39 months following shipment of the Product.

6.3.8 No Other Warranties

Unless modified in writing and signed by both parties, this Warranty is understood to be the complete and exclusive agreement between the parties, suspending all oral or written prior agreements and all other communications between the parties relating to the subject matter of this Warranty, including statements made by salesperson. No employee of ProSoft or any other party is authorized to make any warranty in addition to those made in this Warranty. The Customer is warned, therefore, to check this Warranty carefully to see that it correctly reflects those terms that are important to the Customer.

6.3.9 Allocation of Risks

This Warranty allocates the risk of product failure between ProSoft and the Customer. This allocation is recognized by both parties and is reflected in the price of the goods. The Customer acknowledges that it has read this Warranty, understands it, and is bound by its Terms.

6.3.10 Controlling Law and Severability

This Warranty shall be governed by and construed in accordance with the laws of the United States and the domestic laws of the State of California, without reference to its conflicts of law provisions. If for any reason a court of competent jurisdiction finds any provisions of this Warranty, or a portion thereof, to be unenforceable, that provision shall be enforced to the maximum extent permissible and the remainder of this Warranty shall remain in full force and effect. Any cause of action with respect to the Product or Services must be instituted in a court of competent jurisdiction in the State of California.

Index

[

[HART PORT x COMMANDS] • 23
[HART PORT x] • 21
[MODULE] • 20

A

All Product Returns: • 142
Allocation of Risks • 147
Analyzing Data for Port 1 • 51
Application Port Connection • 84
Auto-Poll Code • 22
Auto-Poll DB Address • 23
Auto-Poll Disabled Mode • 76
Auto-Poll Modes • 71
Auto-Poll Swap Float • 23
Auto-Polling • 73

B

Backplane Application Example • 64
Backplane Data Transfer • 62
Battery Life Advisory • 3
Block Request • 66
Block Response • 66
Burst Mode • 73
Byte Count • 29

C

Clearing a Fault Condition • 57
Cold Boot Block (9999) • 69
COMMAND 00 - Read Unique Identifier • 98
COMMAND 01 - Read Primary Variable • 99
COMMAND 02 - Read Current And Percent Of Range • 100
COMMAND 03 - Read Dynamic Variables • 101
COMMAND 06 - Write Polling Address • 102
COMMAND 108 - Write Burst Mode Command Number • 138
COMMAND 109 - Burst Mode Control • 139
COMMAND 110 - Read All Dynamic Variables • 140
COMMAND 12 - Read Message • 103
COMMAND 13 - Read Tag, Descriptor and Date • 104
COMMAND 14 - Read PV Sensor Info • 105
COMMAND 15 - Read Output Information • 106
COMMAND 16 - Read Final Assembly Number • 107
COMMAND 17 - Write Message • 108
COMMAND 18 - Write Tag, Descriptor and Date • 109
COMMAND 19 - Write Final Assembly Number • 110
COMMAND 33 - Read Transmitter Variables • 111
COMMAND 34 - Write Damping Value • 112
COMMAND 35 - Write Range Values • 113
COMMAND 36 - Set Upper Range Value • 114
COMMAND 37 - Set Lower Range Value • 115
COMMAND 38 - Reset Configuration Changed Flag • 116
COMMAND 39 - EEPROM Control • 117
COMMAND 40 - Enter Exit Fixed Current Mode • 118
COMMAND 41 - Perform Transmitter Self Test • 119
COMMAND 42 - Perform Master Reset • 120
COMMAND 43 - Set PV Zero • 121
COMMAND 44 - Write PV Units • 122
COMMAND 45 - Trim DAC Zero • 123
COMMAND 46 - Trim DAC Gain • 124
COMMAND 47 - Write Transfer Function • 125
COMMAND 48 - Read Additional Transmitter Status • 126
COMMAND 49 - Write PV Sensor Serial Number • 127
COMMAND 50 - Read Dynamic Variable Assignments • 128
COMMAND 51 - Write Dynamic Variable Assignments • 129
COMMAND 52 - Set Transmitter Variable Zero • 130
COMMAND 53 - Write Transmitter Variable Units • 131
COMMAND 54 - Read Transmitter Variable Information • 132
COMMAND 55 - Write Transmitter Variable Damping Value • 133
COMMAND 56 - Write Transmitter Variable Sensor Serial Number • 134
COMMAND 57 - Read Unit Tag Descriptor Date • 135
COMMAND 58 - Write Unit Tag Descriptor Date • 136
COMMAND 59 - Write Number Of Response Preambles • 137
Command Control Blocks • 66
Command Control Data • 19
Command Count • 22
Command Disable Control Block (9903) • 26, 67
Command Enable Control Block (9902) • 26, 67
Command List Error/Status Data Block (9950) • 68
Command List Overview • 24
Commands Supported by the Module • 24
Configuration File • 19
Configuring RSLinx • 15
Connect your PC to the Module • 16
Connect your PC to the Processor • 13
Controlling Law and Severability • 147

D

Data Analyzer • 49, 51
Data Analyzer Tips • 53
DB Address Status • 22
DB9 to RJ45 Adaptor (Cable 14) • 83
Diagnostics and Troubleshooting • 7, 43
Disabling the RSLinx Driver for the Com Port on the PC • 45, 81
Disclaimer of all Other Warranties • 146
Disclaimer Regarding High Risk Activities • 145
Displaying Timing Marks in the Data Analyzer • 51
Done DB Address • 29
Download the Sample Program to the Processor • 14

E

Enable • 26
Enable DB Address • 29
Enabled • 21
Error/Status Offset • 23
Example Field Terminations • 84
Example of HART Command Function 3 • 30
Example of HART Command Function 34 • 32
Exiting the Program • 48

F

Fixed Data • 30
Float DB Address • 27
Function Code • 28
Functional Overview • 7, 61
Functional Specifications • 60

G

General Concepts • 61
General Specifications • 60
Guide to the MVI71-HART User Manual • 7

H

Hardware Specifications • 60
HART Channels • 69
Hart Command Examples • 30
HART Command List • 72
HART Common Practice Commands • 24, 111
HART Common Practice Commands Set • 25
HART Master Menu • 48
HART Universal Commands • 24, 98
HART Universal Commands Set • 24
How to Contact Us
Technical Support • 141, 142

I

Important Installation Instructions • 2
Initialize Output Data • 66
Install the Module in the Rack • 11
Installing and Configuring the Module • 17
Int. DB Address • 28
Intellectual Property Indemnity • 145

K

Keystrokes • 44

L

Ladder Logic • 41
LED Status Indicators • 7, 57
Limitation of Remedies ** • 146
LIMITED WARRANTY • 143

M

Main Logic Loop • 62
Main Menu • 46
Master Command Error List Menu • 55
Master Command List Menu • 56
Master Driver • 72
Max Device Count • 23
Module Configuration • 17
Module Data • 18
Module Power Up • 61
Multi-drop Mode • 78
MVI (Multi Vendor Interface) Modules • 2
MVI71-HART Status Data Area and Error Codes • 18, 65, 92

N

Navigation • 44
No Other Warranties • 147
Normal Data Transfer • 65
Notes • 85

O

Opening the Command Error List Menu • 49
Opening the Command List Menu • 49
Opening the Data Analyzer Menu • 49
Opening the Database Menu • 47
Opening the HART Master Menu • 47

P

Package Contents • 10
Pinouts • 83, 85
Point-to-Point Mode • 76
Poll Interval • 27
Preambles • 21
Primary Master • 21
Procedures for Return of Units Out of Warranty: • 142
Procedures for Return of Units Under Warranty: • 142
Product Specifications • 7, 59
ProSoft Technology® Product Documentation • 4
Protocol Error Codes • 96
Purchasing Warranty Extension: • 143

R

Read Block • 65
Reading Status Data from the Module • 43
Redisplaying the Current Page • 55, 56
Redisplaying the Menu • 48
Reference • 7, 59
Removing Timing Marks in the Data Analyzer • 52
Required Hardware • 34, 44
Required Software • 34, 45
Retry Count • 22
Return Material Authorization (RMA) Policies and Conditions • 142
Returning to the Main Menu • 50, 53, 56
RS-232 Configuration/Debug Port • 81

S

Setting Jumpers • 11
Short Address • 27
Slave List Status • 22
Start Here • 7, 9

Starting the Data Analyzer • 52
Status Data • 18
Stopping the Data Analyzer • 53
Support, Service & Warranty • 7, 141
Swap Code • 27, 28, 29
System Requirements • 9

T

The Configuration/Debug Menu • 34, 43
Time Limit for Bringing Suit • 146
Transferring the Configuration File from MVI71 module to PC • 47
Transferring the Configuration File from PC to MVI71 module • 47
Transferring the Configuration File to the Module • 37
Transferring the Configuration File to Your PC • 35
Troubleshooting • 58

U

Uploading and Downloading the Configuration File • 34
Use Long • 28
User Data • 18
Using the Configuration/Debug Port • 45

V

Viewing Block Transfer Statistics • 46
Viewing Data in ASCII (Text) Format • 52
Viewing Data in Hexadecimal Format • 52
Viewing Module Configuration • 46
Viewing Port Status and Configuration • 50
Viewing the Master Command List Help • 49
Viewing the Next 20 Commands • 56
Viewing the Next 50 Commands • 56
Viewing the Next Page of Commands • 56
Viewing the Previous 20 Commands • 55
Viewing the Previous 50 Commands • 56
Viewing the Previous Page of Commands • 56
Viewing the Slave Status List • 49
Viewing Version Information • 47

W

Warm Boot Block (9998) • 69
Warm Booting the Module • 48
Warnings • 2
What Is Covered By This Warranty • 144, 146
What Is Not Covered By This Warranty • 144
Word Count • 27, 28
Write Block • 65
Write DB Address • 29

Y

Your Feedback Please • 3